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A MANUAL OF MIDWIFERY

A

MANUAL OF MIDWIFERY

BY

THOMAS WATTS EDEN

M.D. C.M.EDIN. F.R.C.P.LOND. F.R.C.S.ED.

OBSTETRIC PHYSICIAN WITH CHARGE OF OUT-PATIENTS AND LECTURER ON PRACTICAL
MIDWIFERY AND GYNÆCOLOGY, CHARING CROSS HOSPITAL
PHYSICIAN TO OUT-PATIENTS, QUEEN CHARLOTTE'S LYING-IN HOSPITAL
SURGEON TO IN-PATIENTS, CHELSEA HOSPITAL FOR WOMEN
EXAMINER IN MIDWIFERY AND DISEASES OF WOMEN TO THE UNIVERSITY OF OXFORD
THE UNIVERSITY OF LEEDS, AND THE CONJOINT BOARD OF THE
ROYAL COLLEGES OF PHYSICIANS AND SURGEONS

WITH 42 PLATES, AND 236 ILLUSTRATIONS
IN THE TEXT

SECOND EDITION

CHICAGO
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PREFACE

TO

THE SECOND EDITION

The time which has elapsed since the first appearance of this manual is comparatively short, and in preparing the second edition it has not been found necessary to make extensive textual alterations. While adhering to the original plan and scope, the book has, however, been thoroughly revised, and an effort has been made to take advantage of the not unfriendly criticisms which were passed upon the first edition.

The second edition contains about fifty pages more reading-matter than the first, as a number of illustrations originally printed in the text now appear as plates. The space thus gained has been utilised exclusively in certain practical parts of the manual which appeared to have been unduly compressed in the first edition. Thus a good deal of additional space has been devoted to the subjects of Abdominal Palpation, the Puerperium, and Infant Feeding; and one or two subjects —*e.g.* Premature Rupture of the Membranes—omitted in the first edition have been briefly discussed. Charts of the normal puerperium and of some of the septic complications of the puerperium have been introduced which, it is hoped, will be useful to students.

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In all there are sixty-three new and original illustrations in this edition, some of which displace old ones, but the great majority are additional. Among these may be mentioned a new series of illustrations of normal and contracted pelves, and also a complete set of plates illustrating the application of forceps.

T. W. EDEN.

London: *May* 1908.

PREFACE

TO

THE FIRST EDITION

It appears that the present time is a suitable one for endeavouring to set forth a concise account of the present position of the theory and practice of midwifery. Many admirable and exhaustive treatises have been written during the last ten years, but they have reached a size which makes it difficult for the average student or practitioner to find time to read them. With such works this volume is not intended to compete. In writing it my aim has been, while omitting nothing which is essential either in theory or practice, to eliminate non-essential or collateral subjects, and to deal with every question briefly, and as far as possible from a practical standpoint. Therefore such subjects as the general anatomy of the pelvic organs and mammary glands have been omitted; they can be best taught in the dissecting-room. And the anatomy of the bony pelvis and pelvic floor has been considered only in connection with the process of labour. But every effort has been made to incorporate recent advances in connection with the development of the human ovum and the pathology of pregnancy, and to present such practical subjects as the management of labour and obstetric surgery in the light of the most recent clinical data. It may therefore be said that this manual is intended, not for the use of specialists, but as a guide to that practical and adequate knowledge of midwifery which is essential alike to the student who desires to satisfy examiners, and to the practitioner whose early years of practice are often so largely occupied with obstetric work.

The illustrations have nearly all been specially drawn for the work by Mr. T. P. COLLINGS; many are original, including nearly all the illustrations of pathological conditions of the ovum; others have been re-drawn from previous publications, by permission of the authors and their publishers.

My cordial thanks are due to my friend Dr. H. RUSSELL ANDREWS for his invaluable assistance in reading the proofs, and to Messrs. J. & A. CHURCHILL for the generous manner in which they have met my requests for illustrations.

T. W. EDEN.

LONDON: *June* 1906.

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PART I

NORMAL PREGNANCY

Ovulation

The ovary is the storehouse in which ova are preserved, and from which they are periodically liberated during the years comprised between puberty and the menopause. *Ovulation* is the process by which ova are discharged from their protecting chambers—the Graafian follicles—into the peritoneal cavity; this process includes the two stages of maturation (ripening) and dehiscence (rupture) of the follicles. A follicle in the resting phase (*i.e.* before ripening has commenced) lies deeply in the cortical layer of the ovary, separated from the surface by a stratum of ovarian tissue of variable thickness. In the ripening process two changes occur: (1) it first approaches the surface and finally becomes partly extruded, forming a protuberance on the ovary, the germ-epithelial covering at that spot being lost; (2) it increases greatly in size. The structure of a ripening follicle is shown in fig. 1. The process of extrusion has not been fully studied, but it is believed to be due partly to the vascular changes in the ovary which accompany ovulation, and partly to contraction of the muscle-fibres of the ovarian stroma, which may be excited by sympathetic nerve impulses; both factors tend to bring about the displacement of the enlarging follicle towards the surface. The causes of rupture are also obscure and probably complex, and many different views concerning them have been advanced. A great increase in the amount of liquor folliculi occurs during maturation, partly by transudation from the congested ovarian vessels, and partly by secretion from the proliferating cells of the granulosa; towards the end of the process hæmorrhage may also occur into the follicle, causing a sudden increase in tension which would easily determine rupture. Clark has pointed out that there is great proliferation of the granulosa cells during ovulation, which he believes also increases the intra-follicular tension. In addition, degenerative processes of the nature of necrosis occur in that part of the wall of the follicle which lies exposed upon the surface, and is unsupported by the ovarian stroma, which so weaken it that it is unable to resist the high tension within, and rupture results. Rupture is therefore due to weakening from degeneration of the wall of the follicle, combined with increased intra-follicular tension.

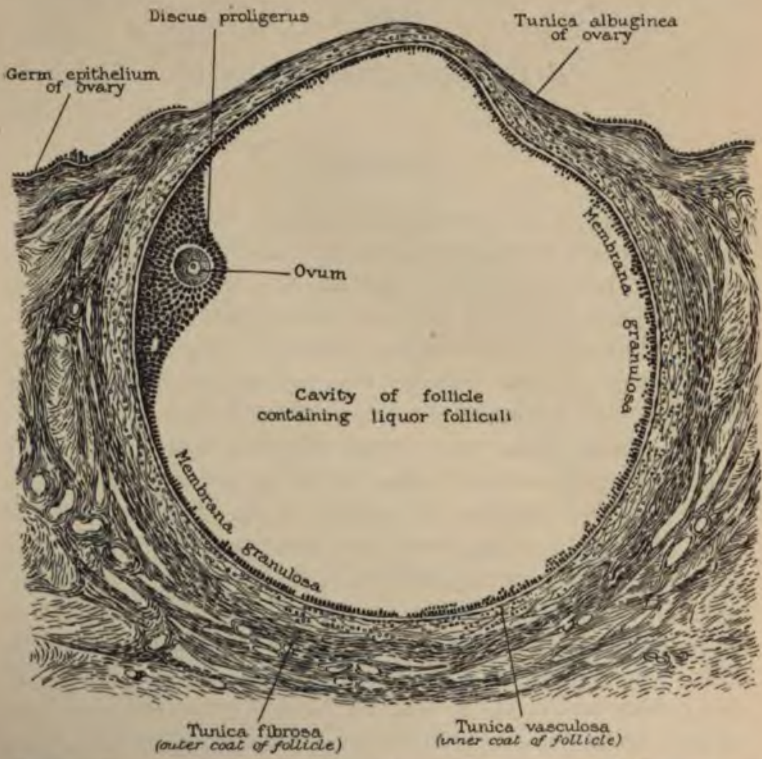
Discus proligerus
Tunica albuginea of ovary
Germ epithelium of ovary
Ovum
Membrana granulosa
Cavity of follicle containing liquor folliculi
Membrana granulosa
Tunica fibrosa (outer coat of follicle)
Tunica vasculosa (inner coat of follicle)

FIG. 1.—RIPENING GRAAFIAN FOLLICLE PROTRUDING UPON THE SURFACE OF THE OVARY. (BUMM.)

When the follicle ruptures, the contained fluid escapes and as a rule carries the ovum with it into the peritoneal cavity. The discus proligerus is usually, but not always, attached to the deepest part of the wall of the follicle. Nagel has shown that fatty degeneration of the granulosa cells occurs during maturation, and this, by weakening the attachments of the ovum, no doubt assists its liberation and escape from the follicle. Occasionally two and sometimes three ova are found in a Graafian follicle. Sometimes Graafian follicles may rupture without detachment of the ovum occurring; this gives the opportunity for ovarian pregnancy to arise if spermatozoa should chance to enter the ruptured follicle (see p. 121); otherwise the ovum would perish *in situ* and non-detachment thus become a possible cause of sterility, but we have no definite information upon this point. The human ovum is a large cell, 200 μ in diameter, consisting of the zona pellucida (cell-envelope), the vitellus or yelk (cell-body, cytoplasm), the germinal vesicle (nucleus), and the germinal spot (nucleolus). An ovum sometimes contains two nuclei, and the nucleolus is not infrequently double. The human ovum, after its escape from the follicle, is shown in fig. 2; it has retained a covering of several layers of cells derived from

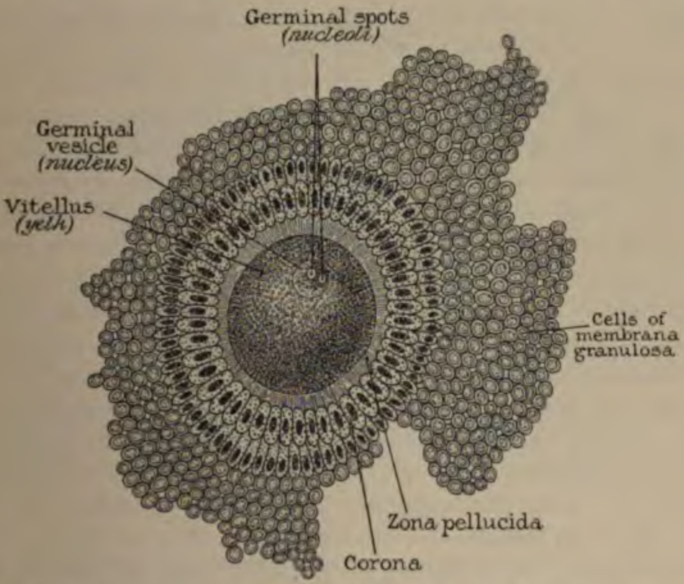

FIG. 2.—A HUMAN OVUM AFTER ITS ESCAPE FROM THE GRAAFIAN FOLLICLE. (NAGEL.)

the discus proligerus, which serve to protect it during its transit to the Fallopian tube; in the tube this protective covering disappears. The cells forming the *corona radiata* are merely somewhat specialised cells of the same origin as those of the discus proligerus.

After its discharge from the ovary the ovum migrates into the Fallopian tube. It was at one time thought that during ovulation the fimbriæ of the abdominal ostium became turgid like erectile tissue and spread over the ovary like the fingers of the hand, so that the ovum was discharged directly into the mouth of the tube itself. This view appears to rest upon fancy, and is opposed to established clinical facts. We know now that the ovum does not always enter the Fallopian tube of the same side, but may pass across the pelvic peritoneal cavity and enter the opposite tube. This phenomenon, known as 'external wandering,' has been demonstrated by cases in which a woman has become pregnant after losing the ovary of one side and the tube of the other; the discharged ovum must, in such cases, pass across the pouch of Douglas. The distance between the mouths of two normally placed Fallopian tubes is not great, and may be reduced by the pelvic congestion accompanying ovulation. The ovum has no locomotive power of its own, and must be carried by peritoneal currents from the ovary to the tube. There is no difficulty in believing that such currents exist in the neighbourhood of the abdominal ostia, for the cilia covering the mucous surfaces of the fimbriæ work towards the uterus and naturally set up currents travelling in that direction in the thin layer of fluid which covers the peritoneum. Their existence in lower animals has been actually demonstrated by injecting insoluble particles into the peritoneal cavity; some of these have afterwards been found in the tubes, having been carried thither by peritoneal currents. When once the ovum has reached one of the tubal fimbriæ, it is probable that peristaltic contractions of the tubal muscle play a part even more important than ciliary action in passing it on to the uterus.

After the Graafian follicle has ruptured and discharged its contents, it undergoes important changes and is henceforth termed the *corpus luteum*. A great deal of attention has [illegible]cently been paid to both the structure and the functions of [illegible]s body, and there is some evidence accumulating that it may normally exert a certain controlling influence upon pregnancy; and that morbid conditions of the developing ovum within the uterus, and of the corpus luteum in the ovary, frequently co-exist.

The cavity of the ruptured follicle is at first filled up with blood effused from the site of rupture; the degenerated granulosa cells are mostly cast off, their place being taken by many layers of actively proliferating polygonal cells of epithelioid character in which a yellow pigment called lutein has appeared. These cells are therefore now called *lutein cells.* So well marked are their characters that their presence in a structure of indeterminate nature is sufficient to prove it to be active ovarian tissue. Their origin from the connective-tissue cells of the tunica vasculosa has now been proved, although they were long believed to arise from the membrana granulosa. Owing to the collapse of the follicle after evacuation of its contents the wall becomes convoluted along its entire length from the formation of folds, and the lutein layer thus comes to acquire its characteristic sinuous outline (fig. 3). Subsequent changes consist in the absorption of the central blood-

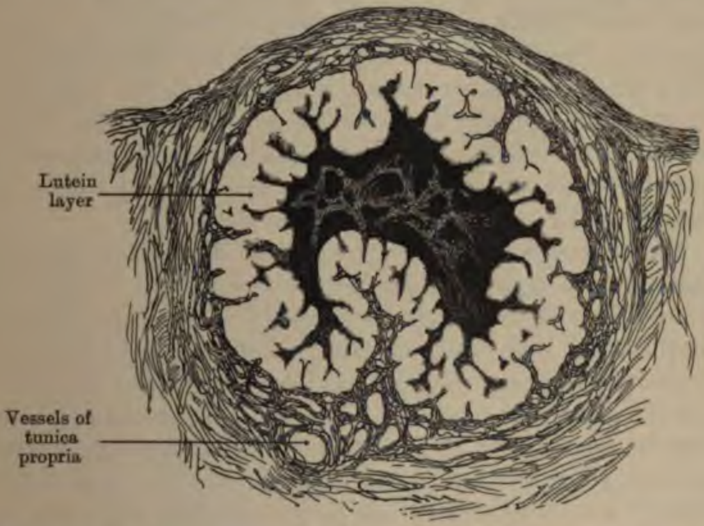

FIG. 3.—CORPUS LUTEUM THREE WEEKS AFTER MENSTRUATION, SHOWING THE CENTRAL BLOOD-CLOT, THE CONVOLUTED LUTEIN LAYER, AND THE VASCULAR TUNICA PROPRIA. (BUMM.)

clot, the complete occlusion of the cavity by proliferating lutein cells, and gradual shrinkage of the entire body. It has been recently shown that masses of lutein cells can often be found scattered through the ovarian stroma during pregnancy, so that their function is probably not limited to the repair of the ruptured Graafian follicle. Soon the lutein cells undergo a kind of hyaline degeneration, losing their nuclei and cell outlines, and becoming transformed into structureless masses. These masses in turn are replaced by connective tissue which invades them from the surrounding ovarian stroma; at this stage it is usually called the *corpus fibrosum* or *corpus albicans.* Finally all trace of lutein cells disappears, and only a small depressed cicatrix remains upon the surface of the ovary to indicate the previous existence of the corpus luteum. The length of time occupied by these changes is variable, becoming longer as age advances; many weeks are probably always required for their completion.

During pregnancy the corpus luteum attains a greater size than when pregnancy does not occur; it may continue to increase in size, retaining its central clot for three or four months, and may come to occupy about one-third of the whole ovarian area. It then gradually undergoes the retrograde changes just described, which are not completed until after the termination of gestation. The large corpus luteum met with in pregnancy was formerly called the 'true corpus luteum,' and that formed when pregnancy does not occur the 'false corpus luteum.' Since there is no essential difference between them, either in structure or in the changes they undergo, these names are meaningless; the one is no more 'false' nor 'true' than the other.

Menstruation

It is undoubtedly true that the processes of ovulation and menstruation are closely related to one another; but whether they are coincident or consecutive, and, if consecutive, which precedes the other, we do not know with certainty. That menstruation is not essential to the occurrence of pregnancy, and that a fertilised ovum may be successfully implanted upon a quiescent endometrium, is well known; for pregnancy may occur either before the establishment of the menstrual function at puberty, after the menopause, or during the temporary suspension of menstruation which usually accompanies lactation. There is, however, much to be said for the time-honoured view that the uterus is in some way prepared

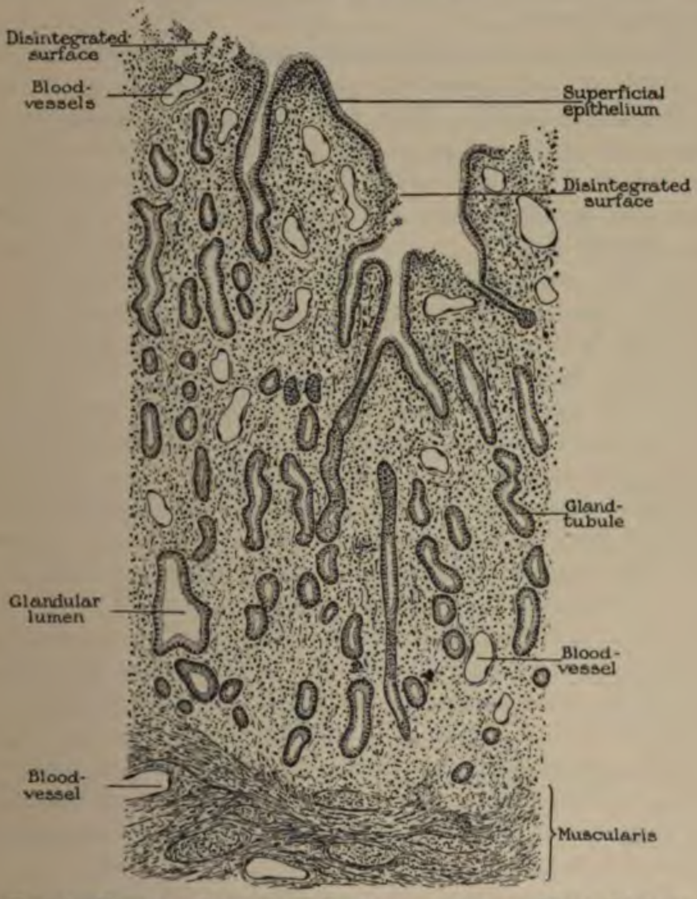

FIG. 4.—VERTICAL SECTION OF ENDOMETRIUM DURING FIRST DAY OF MENSTRUATION. (SCHÄFER.)

by the menstrual changes for the reception of the fertilised ovum; for regularity of the menstrual function is the rule in fertile women, and clinical observations indicate that conception is most likely to occur during the days which immediately follow a menstrual period. This view also receives support from the fact that the changes which the uterine mucous membrane undergoes during menstruation present certain well-marked resemblances to those which immediately follow upon conception and result in the formation of the decidua. So marked is the resemblance that many writers now speak of the endometrium during menstruation as the *menstrual decidua.*

The anatomy of menstruation has been recently studied by Gebhard and others in human uteri removed during a menstrual period. The earliest changes appear to be hyperæmia and swelling of the mucosa, associated with engorgement of blood-vessels, which is most marked in the superficial capillaries (fig. 4). The glands become elongated and slightly dilated, presenting a somewhat corkscrew outline; the inter-glandular connective tissue increases in amount, becomes looser in texture, and sometimes shows traces of infiltration with leucocytes. A little later small interstitial hæmorrhages appear, situated chiefly beneath the superficial columnar epithelium, and as a result patches of cells become thrown off; but the amount of tissue lost in this way is very small. It is uncertain whether the hæmorrhages are due to diapedesis, or to degeneration and rupture of the walls of the capillaries. The menstrual flow comes in part from the denuded patches, but probably the whole of the greatly congested mucosa bleeds more or less. There is no formation of large cells in the connective tissue, such as occurs in pregnancy. The mucous membrane of the cervix takes little or no part in these changes. If an ovum becomes fertilised, further important developments occur in the endometrium, resulting in the formation of the decidua of pregnancy; if not, the congestion subsides, the damaged surface is repaired, and the mucous membrane passes again into the phase of quiescence.

The most important difference between the mucosa during menstruation and the decidua of pregnancy is the formation in the latter of the characteristic decidual cells; in most other respects the resemblance between them is striking.

The Fertilisation and Implantation of the Ovum

The process of fertilisation consists in the union of the male element (spermatozoon) with the female element (ovum).

From what we know of the process in lower mammals there is reason to believe that the spermatozoon and ovum usually meet in the Fallopian tube. We have seen that the ovum may be carried into the tube by peritoneal currents and then passed on by the action of the ciliated epithelium and tubal muscle. The spermatozoon makes its way upwards from the vagina by means of the propelling apparatus with which it is provided, consisting of a long tail which acts like a paddle in driving it forward through the thin layer of fluid which covers the mucous membranes. The activity of the spermatozoa is very great in certain animals, for they can travel from the vagina into the peritoneal cavity in a few hours. It is somewhat doubtful whether their progress is opposed by the action of the ciliated epithelium, for the existence of ascending currents in the secretions of the genital tract has been demonstrated by Bond, who placed insoluble particles of colouring-matter in the vagina, and recovered them in the Fallopian tube on operation a few days later The time occupied by the transit through the tube in the human species is unknown. It is possible for spermatozoa to lie in wait for the ovum in the Fallopian tube for considerable periods; thus they have been found alive in a human Fallopian tube removed three and a-half weeks after the last act of sexual intercourse. Only one spermatozoon is required for the fertilisation of an ovum, and of the enormous numbers found in the seminal fluid nearly all must perish without achieving their physiological destiny. The fertilised ovum is termed morphologically the *oosperm*.

The details of the process of fertilisation naturally cannot be studied in the human species; most of what we know comes from observations upon certain of the echinoderms and ascarides which possess transparent ova, but Sobotta has recently succeeded in studying fertilisation in the mouse. The matter can only be very briefly referred to here.

Immediately before the union of the spermatozoon and ovum, certain changes occur in the nucleus (germinal vesicle) of the latter, resulting in the extrusion of one or two minute portions of its substance, with a covering of protoplasm, beneath the zona radiata (fig. 5, *a*); the extruded portions are termed the polar globules, but their significance is quite unknown, and they soon disappear. As the human ovum possesses no micropyle such as exists in the invertebrates, the spermatozoon penetrates the zona radiata (*z. pellucida*), and when the head has entered, the tail separates and disappears. The human ovum is a large cell 200 μ in diameter, and visible to the naked eye; the head of the spermatozoon measures about 5 μ in length. Attention has recently been paid to the behaviour of the nuclei during fertilisation, and observations on lower animals have established the following facts. The included head of the spermatozoon (*male pronucleus*) and the germinal vesicle of the ovum (*female pronucleus*) each divides into two, and active karyokinetic changes occur. After an interval the four nuclei fuse to form a single nuclear spindle to which an equal number of chromatin loops (*chromosomes*) is contributed by the male and female pronuclei. Every cell formed from the fertilised ovum therefore contains chromosomes derived originally from each parent (Adami).

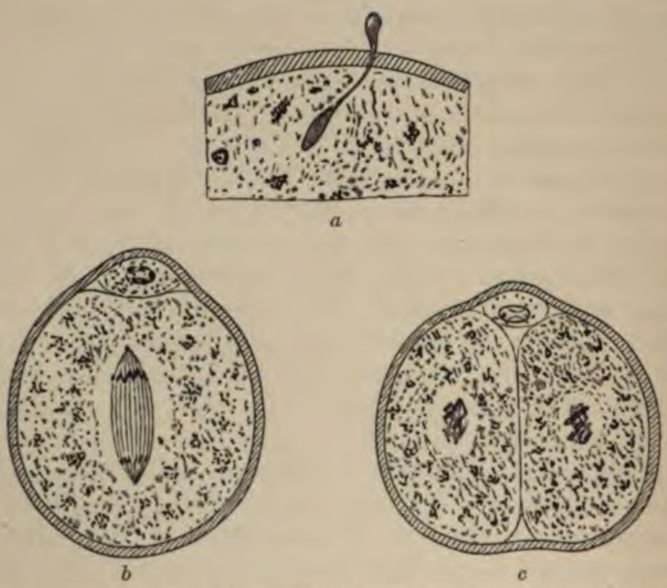

Fig. 5.—The Process of Fertilisation in the Mouse, after Sobotta. (Von Winckel.)

a. Penetration by a spermatozoon. *b.* Formation of polar body, and first division of segmentation nucleus. *c.* Binary division of the ovum.

The fertilised ovum now starts immediately upon a career of extraordinary activity by which all the organs and tissues of an individual human body are formed from it by cell-division and differentiation. The process of cell-multiplication in its earliest stages is known as the *segmentation* of the ovum. The segmentation nucleus first divides into halves, which recede towards opposite poles of the cell (fig. 5, *b*) ; an equatorial or polar line of division is then formed between them which divides the entire cytoplasm in two (fig. 5, *c*). The same process is repeated in the two new cells, and being continued indefinitely the ovum multiplies by binary division into 2, 4, 8, 16, 32, &c. cells. In this manner a solid cluster or globe of cells is formed, called the *muriform body*. This body next becomes converted into the *blastodermic vesicle* by the formation of fluid in the centre, which greatly increases its size, and by excentric pressure causes the cells to become flattened and arranged around the periphery. This process has been described by Van Beneden in the rabbit (fig. 6). At first the wall of the blastodermic vesicle consists of two layers of cells, the outer complete, the inner incomplete; later a third layer of cells is developed between these two where they are in contact. These three layers of cells, known as the *tri-laminar blastoderm*, represent the primitive epiblast, mesoblast, and hypoblast from which all the tissues of the body are subsequently developed. Immediately preceding the appearance of its third layer a small area of thickening is formed upon the blastoderm, which is the first indication of the body of the future embryo, and is called the *embryonic area*; a shallow longitudinal groove soon appears along this area, which is the first foreshadowing of the vertebral column, and is called the *primitive groove*. The embryonic

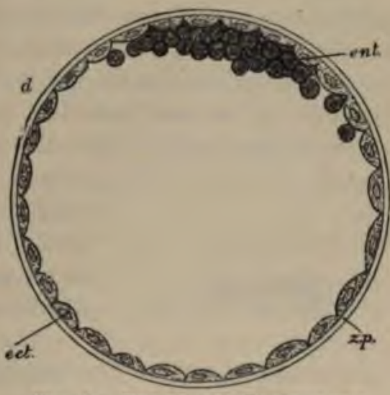

FIG. 6.—BI-LAMINAR BLASTODERM OF RABBIT. (VAN BENEDEN.)

ect. Ectoderm cells. *ent.* Entoderm cells. *z.p.* Zona pellucida.

area, with its primitive groove, is the portion of the blastodermic vesicle which is alone concerned in the development of the body of the embryo; the remainder plays a different part, and it is with this portion that we are now chiefly concerned. Text-books of embryology must be referred to for a fuller description of the foregoing stages and for an account of the development of the epidermal, skeletal, and visceral systems; but the fate of the extra-embryonic portion of the ovum is intimately concerned with the nutrition and development of the fœtus *in utero*, and is therefore of immediate importance in obstetrics.

At this stage of development begins the formation of the special fœtal envelopes, the *chorion* and *amnion*, which fulfil the double functions of nutrition and protection throughout the whole period of intra-uterine life. In the earliest human ovum which has been described—viz. that of Peters, believed to be about the fourth to fifth day of development—these membranes were both fully formed. They appear in the human species probably much earlier (relatively) than in birds—the creatures in whom their development has been most carefully studied.

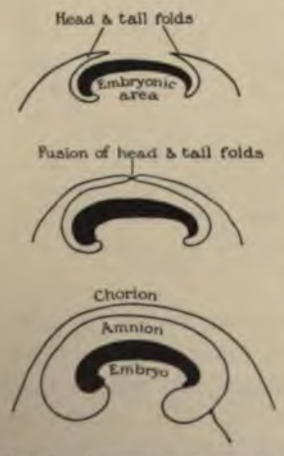

FIG. 7.—SCHEME OF DEVELOPMENT OF THE AMNION IN THE CHICK. (VON WINCKEL.)

The development of the fœtal envelopes in the chick is as follows. Chorion and amnion are developed together, and subsequently differentiated for the special functions they have to fulfil. They are formed from folds which spring up from the head and tail ends, and lateral boundaries, of the embryo, and grow over its dorsal surface. These folds consist of a double layer of epiblast cells with mesoblast cells between them. The inner layer of the blastoderm (hypoblast) takes no share in the process. Gradually they coalesce, producing a membrane which has the form of a closed hood; it consists of a central layer of mesoblast cells, covered externally and internally by a layer of epiblast cells (fig. 7). This single membrane now splits into two, the line of cleavage passing through the centre of the mesoblast layer. Thus two membranes are formed, the outer (further from the embryonic area) having an external epiblastic covering, the inner having an internal epiblastic covering; the former is the *chorion*, the latter the *amnion* (fig. 7).

In Peters's ovum, however, the fœtal envelopes were apparently formed before any trace of the body of the embryo itself, and consequently it is unlikely that the mode of development can be that just described. Recent observations upon the development of lower mammals have led to the belief that a different mode of development of the fœtal membranes occurs in them, and the appearances found in the human ova described by Peters and Graf Spee make it probable that this mode of development obtains in man also. This method is diagrammatically represented in fig. 8. Upon a part of the surface of the blastodermic vesicle the epiblast splits, forming a small space enclosed by epiblast cells; this represents the earliest sign of the amniotic sac (fig. 8, *a*). At the extremities of this space the mesoblast cells proliferate, but more markedly at one end than the other. The epiblastic floor of this primitive amniotic cavity corresponds to the *embryonic area*, and the special proliferation of the mesoblast takes place at the end which ultimately becomes the head of the embryo. The mesoblast cells at the head end now penetrate the roof of the amniotic cavity and split it into two layers, the process gradually passing over to the tail end (fig. 8, *b*, *c*). In this way the amniotic cavity becomes completely cut off by mesoblast cells from the epiblast wall of the blastodermic vesicle. The body of the embryo has by this time become outlined, and, with its amnion and umbilical vesicle, sinks away from the surface; the layer of mesoblast which has formed over the amnion splits in two, and becomes attached in part to the wall of the blastodermic vesicle, in part to the amnion. The blastodermic wall, consisting now of an outer epiblastic and an inner mesoblastic layer, becomes the chorion. The embryo, with its amnion and umbilical vesicle, would now lie free in the interior, but for the fact that a mesoblastic stalk attaches its tail end to the wall of the blastodermic vesicle; this represents the ventral stalk (fig. 8, *c*, *d*). Thus are formed two embryonic coverings; the inner, or *amnion*, is closed from the outset and is cut off from the primitive epiblast by the activity of the mesoblast layer; the outer, or *chorion*, represents the primitive epiblastic wall of the blastodermic vesicle with its mesoblast lining.

It is obvious that this mode of development offers a satisfactory explanation of the very early development in man of the amnion and of the ventral stalk (see p. 19). The early embryo is in this way cut off—except where the ventral stalk is formed—from the periphery of the developing ovum. It carries

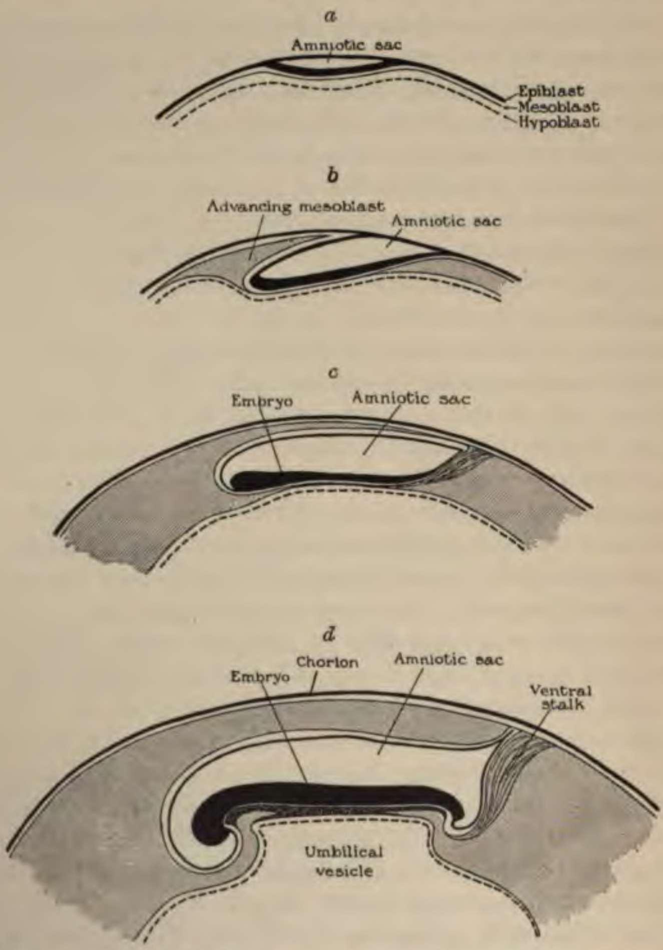

Fig. 8.—Scheme of Development of the Amnion in Lower Mammals, and probably in Man. (Von Winckel.)

with it a certain supply of nutritive material contained in the umbilical vesicle. This structure represents the interior of the ovum cut off from the periphery by the proliferation and splitting of the mesoblast layer. From this source the embryo probably derives nourishment while the chorionic circulation is developing. In birds and reptiles the umbilical vesicle is of large size and no doubt plays an important part; in man and most other mammals it is small and unimportant. As we shall immediately see, changes occur at a very early period in man by which the ovum is enabled to obtain the nutriment it requires directly from the maternal tissues.

From this point onwards we can dispense with the doubtful guidance of comparative embryology, and proceed upon the results of observations upon the early human ovum. From the outset a remarkable difference is apparent between the two fœtal membranes; the amnion is inactive, but the chorion starts at once upon a career of extraordinary activity, the extent and importance of which are probably not yet fully understood. In Peters's ovum the amnion appears as a very small sac, separated by only a narrow interval from the dorsal surface of the embryonic area; it is comparatively inactive and unimportant (fig. 9). Quite otherwise is it, however, with the chorion, which appears as a large oval envelope exceeding many times the diameter of the amnion, and separated from it by a wide interval. Its mesoblastic layer is inactive, but its epiblastic layer presents an extraordinary picture of activity and fulfils functions of the highest importance. In order to understand these functions we must pause to consider the relations of the fœtal to the maternal tissues at this period.

Peters's ovum was found to be imbedded in the decidua, being actually in contact everywhere with the maternal connective tissues, except at a small area where a cap of fibrin, resulting from hæmorrhage and indicating the point at which it had penetrated the decidua, was found upon the superficial pole of the ovum. How did the ovum penetrate the decidua and bury itself in this way? It is believed that the active epiblast of the early chorion exerts a destructive action upon the maternal tissues, and thus excavates a bed for the ovum to lie in. Peters's observation has recently been confirmed in a case of uterine pregnancy (Rossier), and recent observations upon cases of early tubal pregnancy support it in a remarkable manner; for the early tubal ovum has been found surrounded by fibro-muscular tissue, having therefore bored its way through the mucosa into the middle layer of the wall of the tube by the aid of this destructive action. These observations may be said to establish the view that the human ovum becomes attached to maternal structures by imbedding itself in connective tissue, through the destructive action of its proliferating epiblast.

The chorion at this stage completely encloses the embryonic area, which receives additional protection upon its dorsal surface from the amnion. Proliferating with remarkable activity, the chorionic epiblast now forms masses of cubical cells, and also buds, long processes, and large clumps of multinucleated protoplasm (plasmodia). No attempt at differentiation into cells is to be found in the plasmodia. This actively proliferating epiblast layer, partly plasmodial and partly cellular, is called the *trophoblast* (fig. 9), a name which indicates that its chief function is nutritive; it has been applied to the human ovum from the comparative observations of Hubrecht upon the hedgehog.

In the early stages the nutritive organ or trophoblast grows much more rapidly than the embryonic portion of the ovum, and it is interesting to note how greatly its size exceeds that of the embryo in Peters's specimen. In contact with the trophoblast, the maternal connective tissue first degenerates and a certain amount of destruction of cells occurs, making room for the rapidly growing ovum. Then a reaction appears to set in and some hypertrophy of the maternal tissues occurs, resulting in the formation of the large connective-tissue corpuscles which are characteristic of the decidua and are called *decidual cells*. Many maternal capillaries are opened by the destructive action of the trophoblast, and thus maternal blood becomes effused into the tissues. Further, in these positions the trophoblast becomes extensively vacuolated, converting it into a reticular structure, and into these vacuoles passes maternal blood from the ruptured decidual capillaries. In this way a zone of spongy and actively growing tissue is formed, partly maternal and partly fœtal in origin, completely enveloping the embryo and infiltrated with maternal blood; it is in fact a simple form of placenta, and no doubt subserves at this time the functions which are afterwards

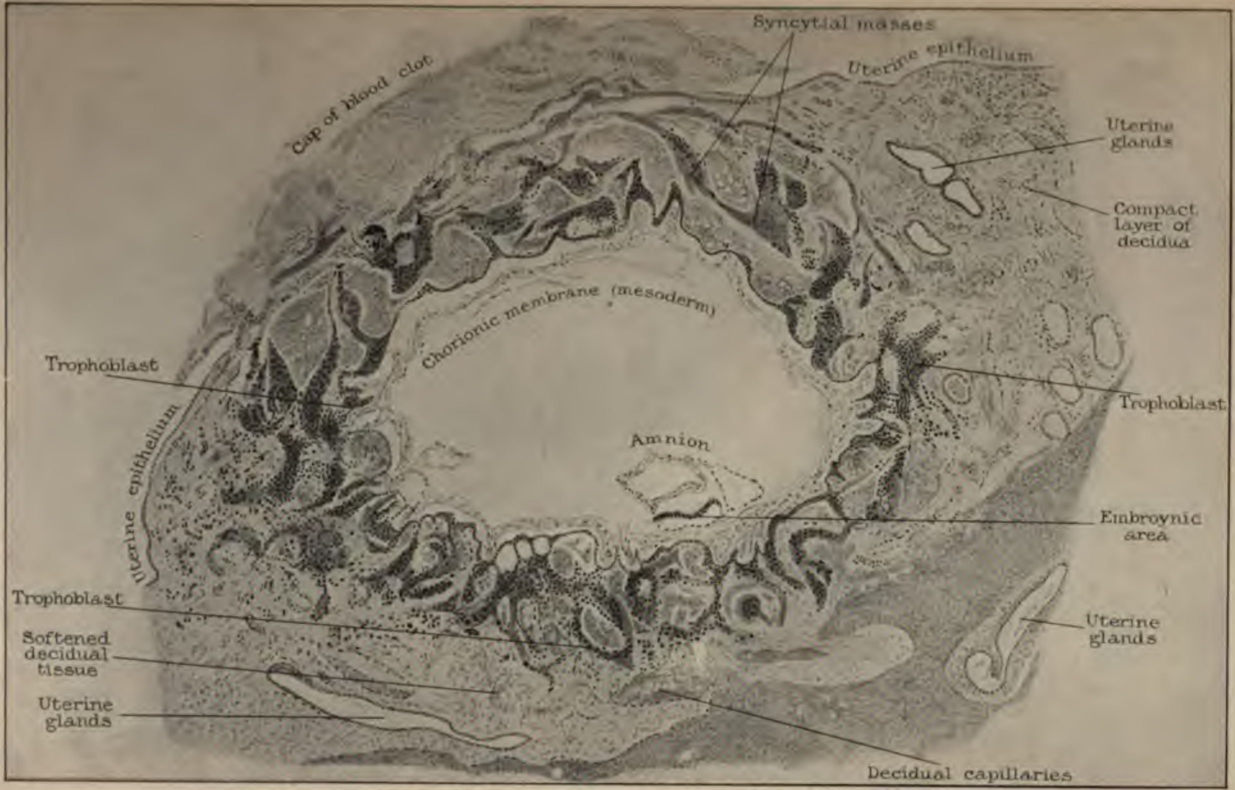

FIG. 9.—PETERS'S OVUM (FOURTH TO FIFTH DAY) IN SITU. (PETERS.)

[*To face p.* 16.

taken over by that organ. This zone of spongy tissue was also described in the hedgehog by Hubrecht, and termed by him the *trophosphere*. The blood-filled vacuoles of the trophosphere are the earliest representatives of the intervillous spaces of the mature placenta; the maternal blood in them does not coagulate, but there is no definite circulation.

Under the stimulus of the implantation of the fertilised ovum in the uterus, the endometrium of the whole body of the organ becomes converted into the decidua, but the mucous membrane of the cervix remains practically unaltered (fig. 10). This reaction of the endometrium in pregnancy is of great interest and will be referred to again in connection with tubal gestation. As the ovum enlarges, it becomes possible to speak of three distinct portions of the decidua: (1) a large extent of the membrane which is not in direct contact with the ovum at all, called the *decidua vera*; (2) a portion in contact with

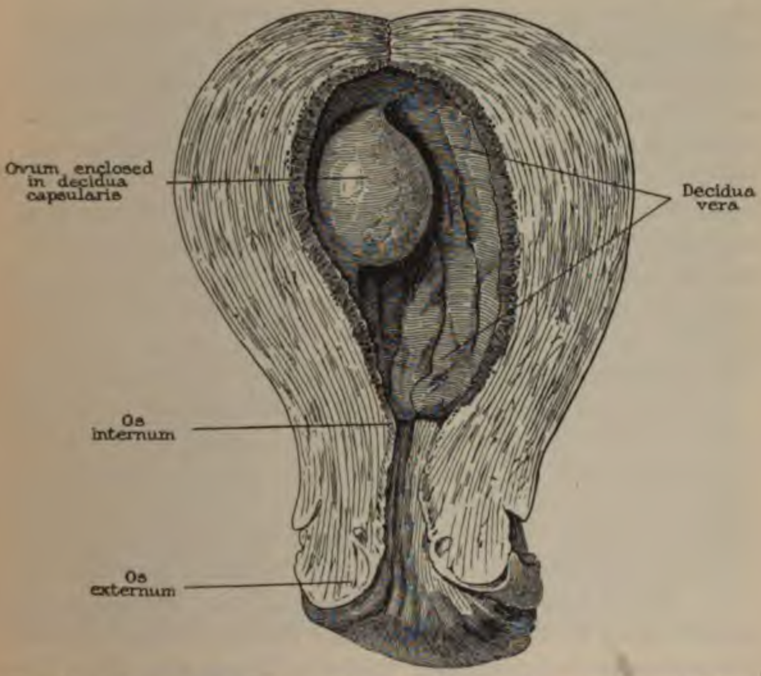

FIG. 10.—UTERUS WITH OVUM OF FOUR WEEKS' GESTATION. NATURAL SIZE. (BUMM.)

the base of the ovum, called the *decidua basalis* or *serotina*; and (3) a portion enclosing the remainder of the ovum, termed the *decidua capsularis* or *reflexa* (fig. 10). The term 'decidua reflexa' indicates an old view of the formation of this portion of the membrane, which was that the ovum attached itself to the *surface* of the decidua, and later on became enclosed by the growth of a ring of decidual tissue around it, which, ultimately meeting over the free pole of the ovum, completely enveloped it. We now know that no such process occurs: the ovum is imbedded in the decidua from the outset; decidua and ovum develop *pari passu* in this position, thus preserving the original relation; and 'decidua capsularis' is therefore a better term than 'decidua reflexa.' The decidua basalis is the area upon which the placenta is subsequently formed in the great majority of instances, although exceptions occur which will be referred to later on. The word 'serotina' expresses the view of William Hunter that the ovum entered the uterus from the tube beneath the decidua, raising it up from the wall of the uterus; later on a new formation of decidua occurred at the base of the ovum (*serotinus*=late). We are unacquainted with the functions of the decidua vera.

All parts of the decidua have the same general structure, and, as has been already noted, the membrane bears a striking resemblance to the menstruating endometrium. The principal change which has occurred is the differentiation of the decidua into two layers, the superficial *compact* and deep *cavernous* layers. The deep layer is rendered cavernous by very marked dilatation of the deep portions of the uterine glands which form spaces of varied size and shape, with an incomplete and degenerated epithelial lining (fig. 12). The superficial layer consists of a compact mass of 'decidual cells' in which appear here and there dilated capillaries—the 'decidual sinuses' (fig. 11). The greater part of the surface epithelium is lost, and very few glands can be seen in this layer. The 'decidual cells' are specialised connective-tissue corpuscles; in most situations they are closely packed together and become polygonal from pressure; where the arrangement is looser they assume a spherical or oval shape. Their nuclei are large and globular. Among the decidual cells are seen numerous small interstitial hæmorrhages, and here and there some leucocytic infiltration (fig. 11). The differences

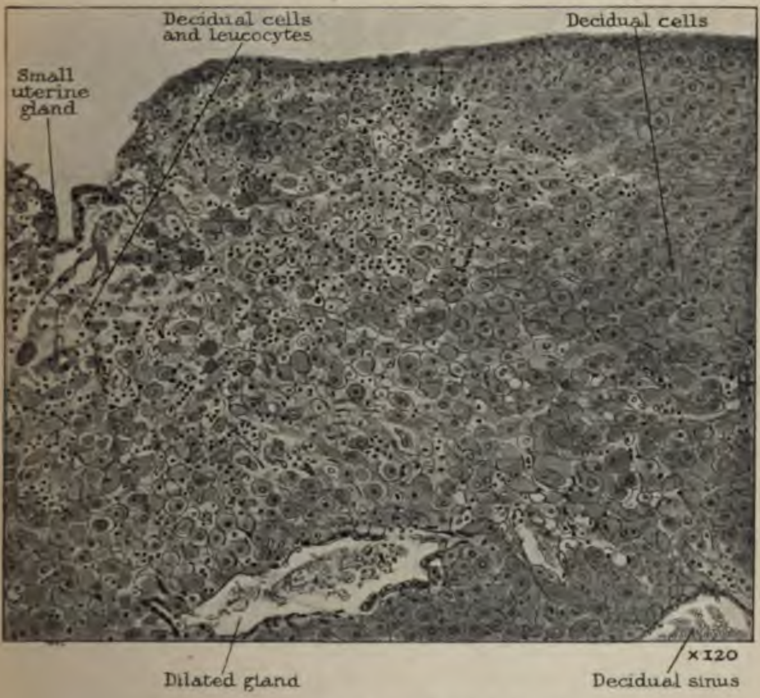

FIG. 11.—DECIDUA VERA ; COMPACT LAYER.

To the right of the figure the decidual cells are closely packed and polygonal.

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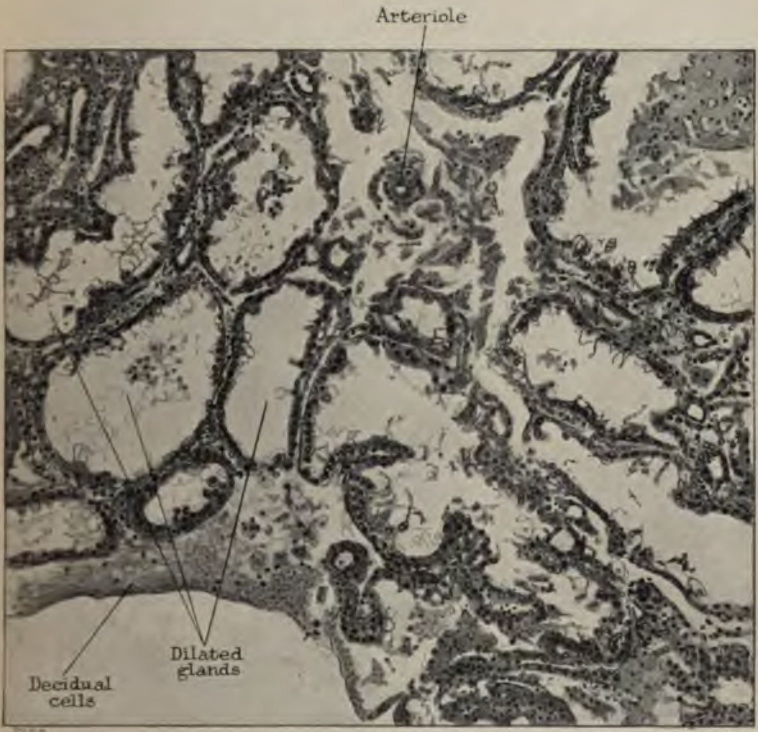

FIG. 12.—DECIDUA VERA; CAVERNOUS LAYER.

[*To face p.* 18.

between the decidua and the normal endometrium may be briefly summed up as follows: (1) formation of decidual cells; (2) hypertrophy and dilatation of the deepest portions of the glands; (3) increased vascularity, leading to formation of widely dilated capillaries or 'sinuses,' and interstitial hæmorrhages; (4) extensive loss of the surface epithelium; (5) division into two layers—the superficial compact, the deep cavernous; (6) great increase in thickness—endometrium about $\frac{1}{25}$ of an inch, decidua $\frac{3}{4}$ to $\frac{7}{8}$ of an inch.

It will be obvious that at the early stage (fourth to fifth day of development) reached by Peters's ovum, vital connections exist between the ovum and the uterus, maintained by specialised tissues of combined fœtal and maternal origin. The further development of these connections, leading to the formation of the highly specialised placenta, must next be traced.

Chorion and Placenta

From Peters's ovum we pass to one described by Graf Spee, belonging to the beginning of the second week of development; the gap existing between these two has not, up to the present, been filled by observations upon the human ovum. A section through a portion of the wall of this ovum is shown in fig. 13. The general relations of the embryonic area to its envelopes are the same as in Peters's ovum. Two new points of great importance are, however, to be noted: (1) the chorion shows the presence of branching villi of a somewhat complicated nature; (2) the embryonic area with its yolk-sac is seen to be united to the chorion by a mesoblastic stalk—the abdominal pedicle (ventral stalk)—which is the precursor of the umbilical cord. The relatively small size of the amnion is well shown in the figure, which will be seen to resemble in a striking manner the diagrammatic representation of the development of the amnion shown in fig. 8. The chorionic villi are perfectly formed, consisting of an outer epiblastic covering showing great proliferative activity, and a highly vascular mesoblastic core of connective tissue of embryonic type. The relations of the chorion to the decidua have also at this period undergone marked changes. These relations can best be seen, however, in another ovum of about the same period—that of Leopold, shown in fig. 14. This ovum, which was examined *in situ*, was estimated to belong to the end of the first week of development; it is, however, in all probability a little older than this.

In Leopold's ovum it is apparent that the decidua and the chorion are separated by a considerable space except at the two poles: at the base a process of the decidua basalis directly supports it: at the free pole chorion and decidua are united over quite a considerable area, corresponding to the position of the fibrin cap in Peters's ovum. The space between chorion and decidua is termed the *chorio-decidual space*, and is occupied by numerous villi, seen in section in the figure. Most of the villi contain blood-vessels; some are free, some are attached to the decidua by their tips; in the spaces between them lies fresh maternal blood, and one or two delicate maternal capillaries can be seen opening into the chorio-decidual space. Here, then, is a further development of the

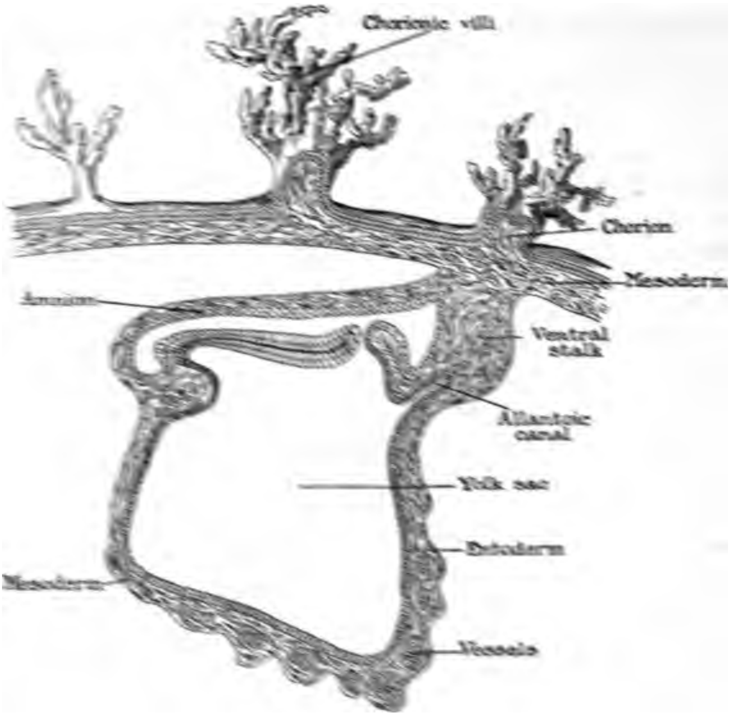

FIG. 13.—SAGITTAL SECTION OF GRAF SPEE'S OVUM. (GRAF SPEE.)

trophosphere seen in Peters's ovum; the chorion has become villous, and a system of spaces containing maternal blood has been formed around the villi. This is obviously a great advance towards the formation of a placenta with a definite maternal circulation. In a second, somewhat older ovum, Leopold found that the whole surface of the chorion was beset with villi, the chorio-decidual space being continuous around the entire ovum. There is probably no definite maternal circulation through the chorio-decidual space; but the villi are certainly vascularised, and nutritive materials from the effused maternal blood can be taken up by osmosis into the fœtal circulation. The arrangement corresponds, in fact, to a simple form of diffused placenta surrounding the whole ovum, and shows a distinct advance in construction upon the trophosphere previously described. In this manner

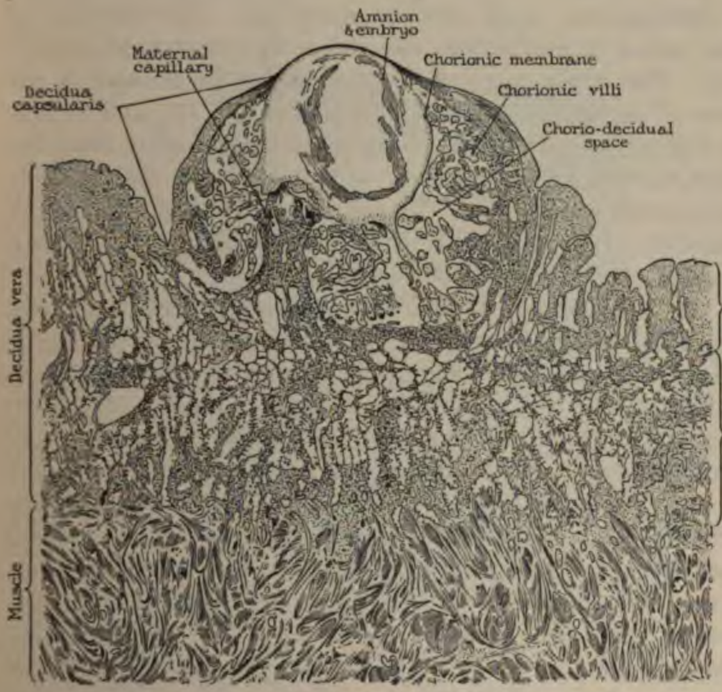

Fig. 14.—Leopold's Ovum in situ; beginning of Second Week. (Leopold.)

the nutrition of the ovum is provided for, while time is gained for the formation and growth of the highly complex discoidal placenta. It is not until the end of the sixth week that the placenta begins definitely to be formed, so that the chorio-decidual space plays an important part in the nutrition of the ovum for a considerable period, from the second to the sixth week.

The structure of the chorion during the first six weeks of development must now be described. The chorion at this period is everywhere covered with complex branching villi. These villi are definitely arranged in clusters in an ovum of about eight weeks' development (fig. 15), and form a thick layer of delicate branching processes springing from the outer surface of the chorion, which in places can be seen as a smooth membrane. The chorion consists of three main elements: (1) an epithelial covering; (2) a connective-tissue stroma; (3) a system of blood-vessels.

(1) The chorionic epithelium is the outer covering; it is frequently called the trophoblast. It consists of two distinct layers—an *outer* layer of multinucleated protoplasm, undifferentiated into cells; and an *inner* layer of large well-defined cells with oval nuclei, frequently resting upon a distinct basement membrane. The outer layer is termed the *syncytium*, or simply the *plasmodial layer*; the latter is termed the *cellular layer*, or, after its discoverer, the *layer of Langhans*. Both layers are of epiblastic origin, although for a long time it was thought that the outer layer was derived from the decidua and was therefore maternal. The whole of the chorionic epiblast is originally cellular, and the syncytium is formed by fusion of layers of contiguous cells. During the early months the syncytium displays great activity, throwing out enormous numbers of buds and processes (fig. 16), many of which develop into new villi; sections of these buds may appear under the microscope as isolated plasmodial masses, and were formerly termed 'giant cells.' The cells of Langhans are also very active; they proliferate freely at the tips and sides of the villi, especially where these become attached to the decidua. Frequently also isolated clusters of them, with a more or less complete covering of syncytium, are seen cut across in sections of the young placenta. The latter are called the islets of Langhans, and were formerly regarded as decidual

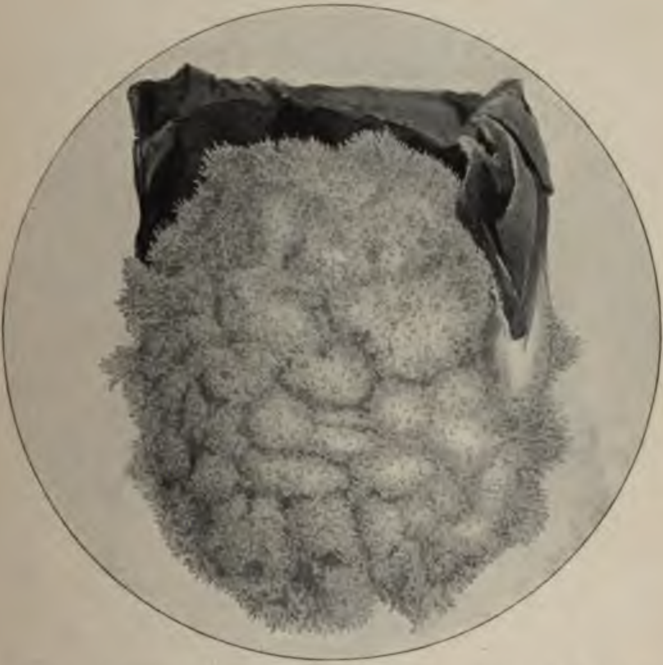

FIG. 15.—COMPLETE OVUM 3·5 CM. × 4·25 CM.; ABOUT SIXTH WEEK OF DEVELOPMENT.

(CHARING CROSS HOSPITAL MUSEUM.)

The chorion is beset with villi, which are arranged in clusters. The dark area in the upper part is blood-clot.

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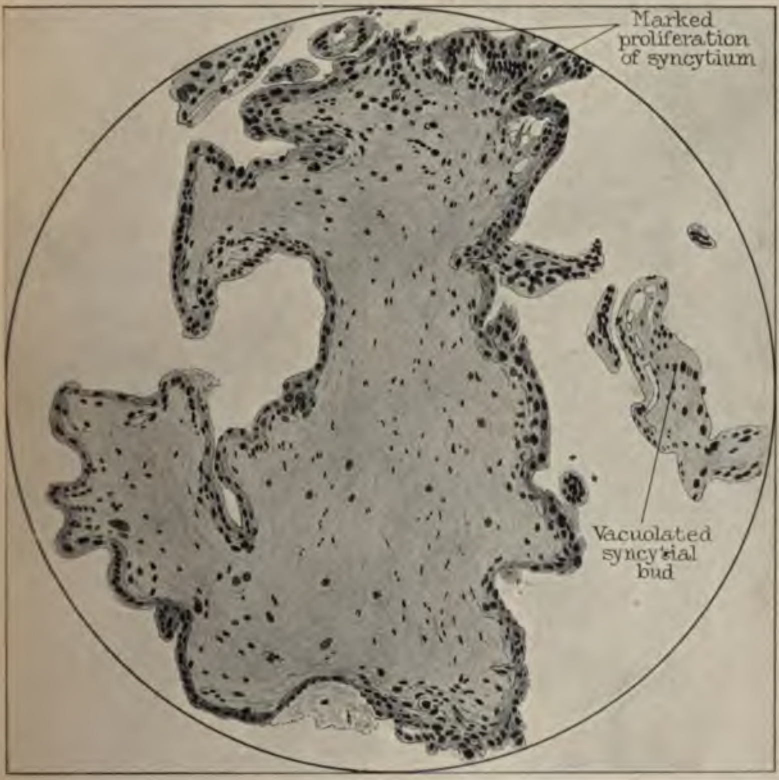

FIG. 16.—VILLUS FROM OVUM OF SIX WEEKS' DEVELOPMENT, SHOWING APPEARANCES OF YOUNG SYNCYTIUM.

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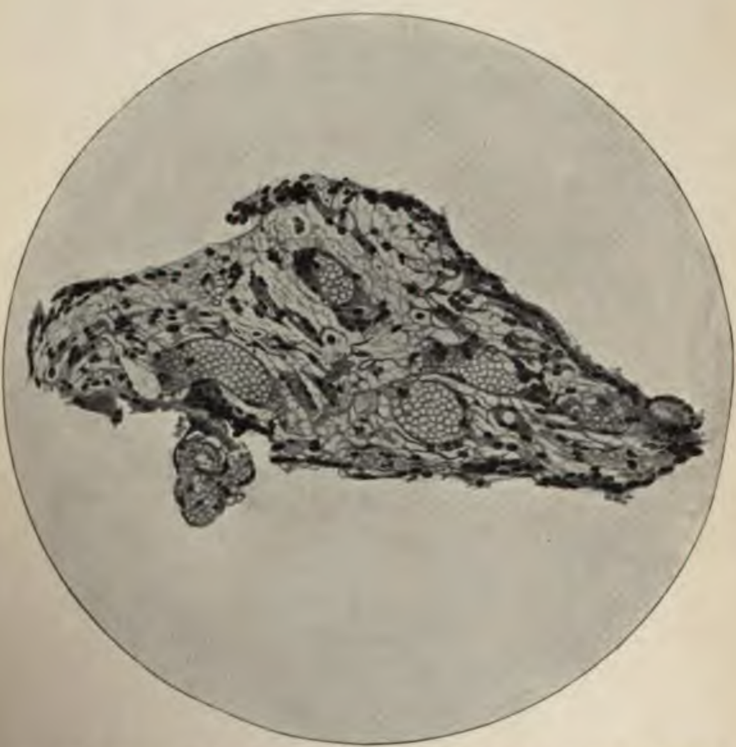

FIG. 17.—NORMAL VILLUS OF FULLY FORMED PLACENTA, SHOWING WIDE BLOOD-FILLED CAPILLARIES.

It will also be noted that the epithelial covering is atrophied and incomplete.

[*To face p.* 23.

in origin. The young syncytium always contains a large amount of glycogen and very finely divided fat.

(2) The stroma is a delicate reticulum of connective tissue, embryonic in type, which supports the blood vessels; in the larger chorionic branches it is more compact than in the terminal branches or villi. The interstices form a system of anastomosing channels which are probably of the nature of lymphatics.

(3) The blood-vessels are the terminal ramifications of the umbilical arteries and veins; in the larger chorionic branches they lie in the axis; in the terminal villi capillaries only are found, and these lie immediately beneath the epithelium, where they run a tortuous course and anastomose freely. In an injected placenta, a tiny thread of colouring-matter can often be traced from a villus into one of its syncytial buds, showing the commencement of vascularisation. The villi are extremely vascular, and often appear under the microscope to be as full of blood as a soaked sponge (see fig. 17); between the fœtal blood in the villi and the maternal blood in the chorio-decidual space nothing intervenes except the chorionic epithelium and the endothelium of the fœtal capillary wall.

The chorion retains the characters just described until the second half of the period of gestation, when changes in its structure occur which will be referred to later on. The chorio-decidual relations undergo no marked change until the latter half of the second month, when the formation of the discoidal placenta is begun. This process simply consists in the specialisation of a part of the chorion to perform the work previously done by the whole. As the placenta develops the villi covering the general surface of the chorion become devascularised, undergo atrophy, and disappear early in the third month. At the placental site—the base of the ovum—the villi increase greatly in size, number, and complexity, while important changes also occur in the underlying decidua. A diminution in the total area of the villous chorion is thus compensated by the specialisation of a part of it.

The changes which now occur at the placental site lead up to three important results: (1) by repeated subdivision enormous numbers of chorionic stems and terminal divisions (villi) are produced; (2) firm attachments are formed between the fœtal and maternal elements; (3) a definite maternal circulation is established through that portion of the chorio-decidual space which is in relation to the decidua basalis.

(1) The *enormous numbers of villi* present in the placenta will be understood from an examination of fig. 18, which represents a portion of a vertical section through the placenta. The larger chorionic stems spring from the chorionic membrane underlying the amnion, and, dividing irregularly, terminate in an indefinite number of small divisions termed villi. Some of these stems traverse the whole thickness of the placenta, so that their terminal villi reach the decidua basalis. Both villi and larger branches appear in the section to be of very diverse size and shape, but this is partly due to the varying angles at which they have been cut. The larger branches all contain large vessels, and through the centre of the largest of all one or more arteries and veins, running side by side, can usually be traced. The villi are not in contact with one another, but are separated by spaces—the intervillous spaces. It will be obvious that these spaces form throughout the placenta an elaborate system of branching channels allowing free communication to take place between one part of the organ and another. Through the general system of intervillous spaces the maternal circulation is carried on, so that a gentle stream of maternal blood is perpetually flowing around the villi. When the large numbers of these villi are borne in mind, it will be evident that the superficial area of contact between the fœtal structures and the maternal blood in the placenta is of very great extent. In many places adjacent villi are united to one another by small deposits of fibrin; isolated syncytial masses are seen here and there, and in places clusters of nuclei, representing areas of proliferating Langhans' cells, can be seen on the surface of a villus or free in the intervillous spaces (islets of Langhans). A good deal of maternal blood can be found in the intervillous spaces when care is taken to prevent it from escaping during the preparation of the tissue for microscopic section.

(2) The *placental attachments* consist of (*a*) a firm union between large numbers of villi and the surface of the decidua basalis; and (*b*) a special development of the decidua at the margins of the organ. (*a*) The attachment of the villi to the decidua presents some interesting features. Where the two come into contact, the syncytial layer of the chorionic

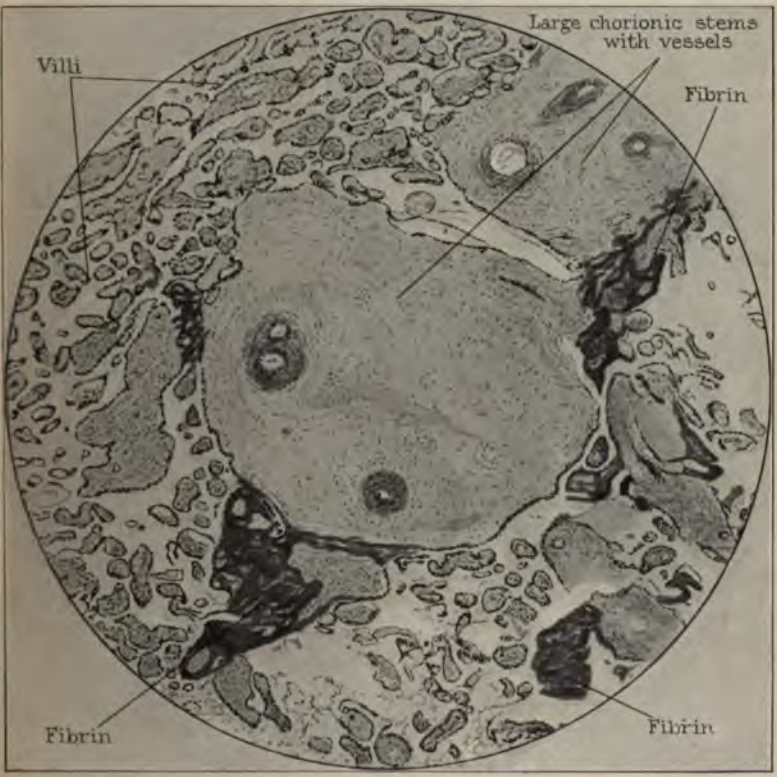

FIG. 18.—FULLY DEVELOPED PLACENTA: EIGHTH MONTH.

In the larger stem is a section of an artery with lumen narrowed by endarteritis.

[*To face p.* 24.

the imagination is required to carry the student from the vacuolated trophosphere of the first week to the chorio-decidual space of the second, and from the latter to the intervillous spaces of the placenta itself. The intervillous spaces are of course progressively developed from the vacuolated spaces of the trophosphere. The moment at which maternal blood begins to circulate we do not know, for, as has been said, there was in all probability no actual circulation through the chorio-decidual space in Leopold's ovum, although a few small capillaries were found opening into it. During the development of the placenta other and larger maternal vessels become laid open, so as to communicate with this space, and the active agents in the production of this important change are the chorionic villi. The destructive influence exerted upon maternal tissues by the young chorionic epithelium has been referred to; evidences of penetration of the walls of maternal vessels by syncytial buds and processes are abundant in the developing placenta, where all stages of the process may be traced in tissue cut into serial sections. The vessels thus penetrated are probably merely the dilated capillaries or 'sinuses,' which have been described as occurring in the endometrium of menstruation and in the decidua—*i.e.* they are vessels the walls of which consist merely of an endothelial coat, and which therefore offer but a feeble resistance to the phagocytic action of the chorionic epithelium. After having been thus laid open they lose their endothelial lining. It is often difficult to distinguish afferent from efferent maternal channels, since both arise from dilated capillaries. A minor result of phagocytic action is that the surface of the decidua basalis becomes irregularly excavated and presents a series of deep trenches with intermediate septa. Most of the maternal vessels open into the intervillous spaces on the floor of these trenches (fig. 20). The maternal circulation through the placenta is probably slow. The coiling course of the uterine arteries in the muscular coat diminishes the force of the current entering the placenta; the outflow from the intervillous spaces is perhaps aided by the intermittent uterine contractions characteristic of pregnancy, which may have the effect of aspirating the blood into the veins. Towards the middle of pregnancy the sub-placental sinuses assume very large proportions, and their closure after the

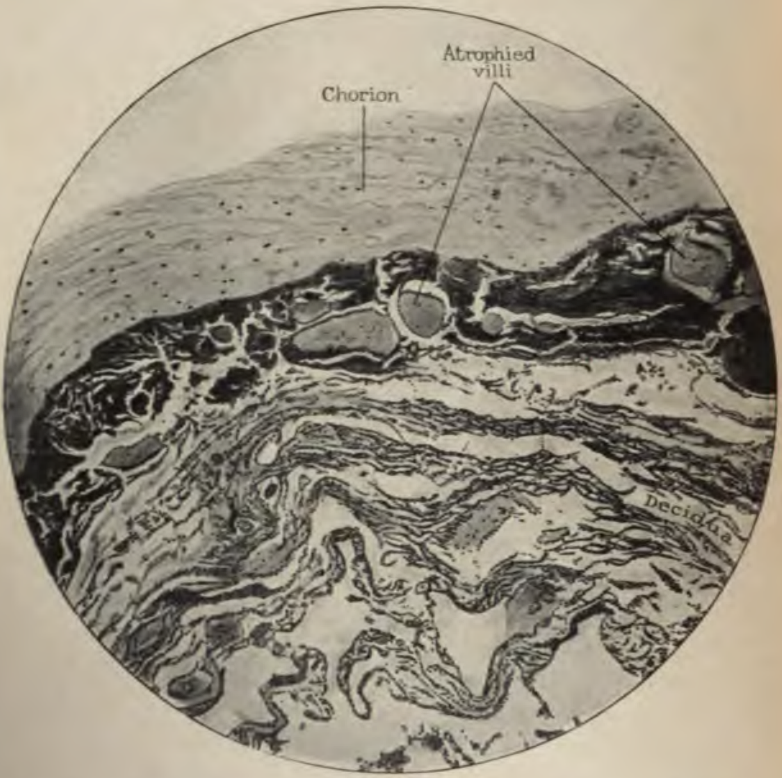

FIG. 21.—SECTION THROUGH THE MEMBRANES NEAR THE PLACENTAL MARGIN.
The atrophied villi show remains of their epithelial covering.

[*To face p.* 27.

placenta has been shed is a matter of vital importance to the life of the mother.

Concurrently with the formation of the placenta, the villi of the extra-placental chorion atrophy and become functionless, converting that portion into a smooth membrane to which the name *chorion læve* is applied; the placental chorion is termed the *chorion frondosum*. Chorion læve and decidua capsularis are not united by intergrowth as are chorion frondosum and decidua basalis.

As these changes progress the chorio-decidual space outside the placental area becomes obliterated by the pressure of the growing ovum; atrophied villi surrounded by deposits of fibrin may always be found in the membranes at term if looked for under a microscope (fig. 21). The placental area grows very rapidly during the first few weeks of its formation, until at the end of the third month, when the ovum fills the uterine cavity, it occupies about one-fourth to one-fifth of the total area of the surface of the uterine walls. Afterwards it grows *pari passu* with the uterus, and the same proportion is preserved up to term.

The decidua vera undergoes no notable development during pregnancy, and when the ovum grows large enough to fill the uterine cavity completely—*i.e.* about the beginning of the fourth month—the decidua capsularis becomes apposed to it, and at term these two portions of the maternal membranes are inseparable. Up to the end of the third month a space exists in the uterine cavity below the ovum, bounded above by the decidua capsularis, laterally by the decidua vera, and below by the os internum; it is called the *decidual space* (figs. 30 and 31). When the two portions of the decidua become apposed, the decidual space is obliterated. At term the capsularis has undergone considerable atrophy from pressure, but the vera fairly preserves its general characters. This is of importance in relation to the process of shedding the placenta.

Upon the maintenance of the relations just described, between the fœtal and maternal elements of the placenta, the nutrition of the fœtus *in utero* entirely depends. After the formation of the firm chorio-decidual attachments, accidental separation of the two is not so readily brought about as at earlier periods; hence the diminished liability to abortion after the third month.

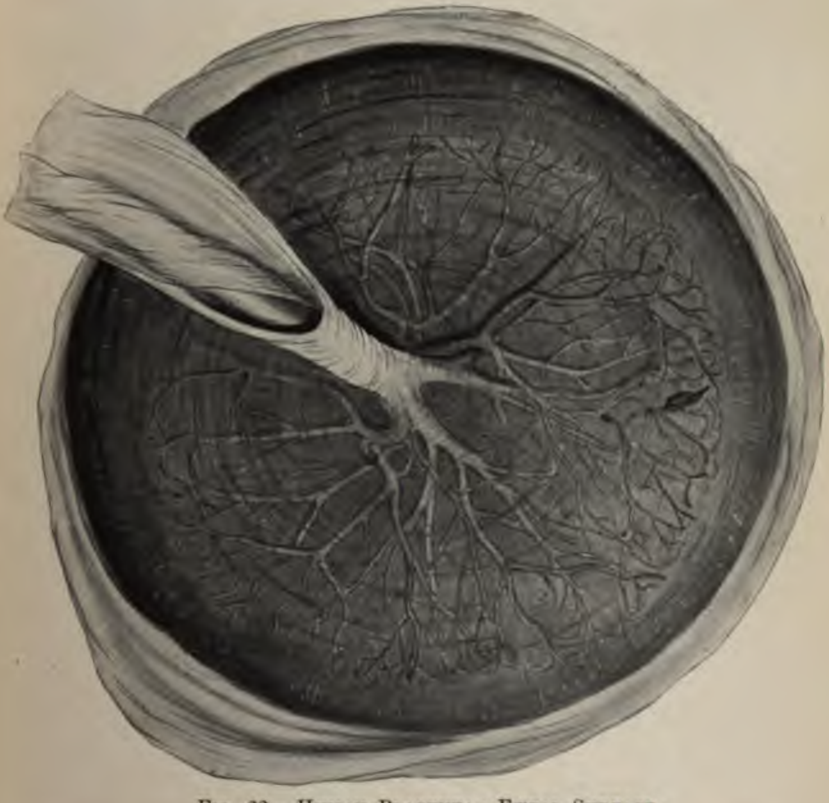

FIG. 22.—HUMAN PLACENTA: FŒTAL SURFACE.

The amnion has been stripped off and folded round the cord; the chorion læve is gathered round the margin of the placenta.

[*To face p.* 28.

defined areas, varying in size, under normal conditions, from that of a millet-seed to that of a filbert. They are most numerous on the uterine surface and on the marginal cotyledons. The superficial layers of the decidua basalis undergo a form of degeneration known as fibrinous degeneration, the decidual cells becoming entirely lost. In addition, extensive thrombosis occurs in the sub-placental sinuses during the later months of pregnancy, the cause of which is not well understood, but which certainly interferes to some extent with the freedom of the maternal circulation.

From about the fifth month onwards the chorionic epithelium consists of only one layer—the syncytium; the layer of Langhans has disappeared. The syncytium is also much less active in the later than in the earlier months, throwing out comparatively few buds and processes; and as term approaches this layer becomes atrophied and incomplete (fig. 17).

It is possible that these degenerative changes limit the duration of pregnancy, and participate in causing the onset of labour by rendering the placenta incapable of providing for the continually increasing nutritional requirements of the fœtus.

Amnion, Umbilical Cord, and Fœtus

Amnion.—This membrane consists of an outer layer of mesoblast and an inner layer of epiblast. Although at first greatly outstripped in growth by its companion membrane, the chorion, the two soon come together and remain in loose contact by their mesoblastic surfaces, but no vital union takes place between them. The fully formed amnion consists of a single layer of cubical or low columnar epithelium resting upon a stratum of loose connective tissue. As pregnancy advances the epithelium becomes flatter. The amnion is firmly united to the umbilical cord at its point of insertion into the placenta, so that it cannot be stripped off the cord, although it is readily separable from both the placental and extra-placental chorion (*chorion frondosum* and *chorion lœve*).

At an early period fluid (the liquor amnii) appears within the amnion, separating it from the dorsal surface of the embryo. It gradually increases in quantity as development advances, until at term it amounts on an average to one or two pints; variations from ten to fifty ounces are, however, not uncommon under normal conditions. At term it is a clear pale fluid of low specific gravity, and its composition, according to Hoppe-Seyler, is as follows:

Water	98·41 per cent.
Albumen	0·19 „
Inorganic salts	0·59 „
Extractives	0·81 „
	100·00

The amount of albumen present in the early months is much higher than this, and may reach 10 per cent. The most important extractive is *urea*, which is present in traces from the sixth week onwards. Various matters in suspension are also found, such as lanugo hairs, epidermal scales, cells derived from the amniotic epithelium, and particles of vernix caseosa detached from the skin of the fœtus. Glucose may be found in cases of diabetes. The function of the amniotic fluid is mainly protective. It assists in maintaining an even temperature, acts as a buffer against external injuries, equalises pressure, allows free movements of the fœtus, and flushes the passages from within with a sterile fluid during labour. Nutritive value has been claimed for it on the ground that it is swallowed by the fœtus during the later months of gestation. Certainly lanugo and epidermal scales are not uncommonly found in meconium, and there is no doubt that they have entered the alimentary canal by being swallowed with liquor amnii; sometimes also balls of fine lanugo hairs have been found in the stomach of a dead fœtus. It is possible, therefore, that fluid obtained by swallowing liquor amnii may be of use in the general metabolism of the fœtus.

Umbilical Cord.—This structure connects the body of the fœtus with the placenta. Its earliest appearance in the human ovum is shown in the specimen of Graf Spee (fig. 13), where a band of mesoblastic tissue is seen uniting the embryonic area, with its amnion and umbilical vesicle, to the chorion. This band was previously described by His, who termed it the *ventral stalk*. Along this stalk pass the fœtal vessels which vascularise the growing chorion; they are branches of the posterior end of the primitive abdominal aorta. Later the *allantois* also grows into it; this structure is an outgrowth from the hinder end of the primitive gut, and in lower mammals it is larger, and plays a much more important part, than in man. Sometimes in the human ovum the allantois does not extend as far as the chorion at all; and according to His the ventral stalk may be vascularised before its appearance, so that it is evident that the part which it plays in the development of the umbilical cord is a secondary one. Later on the *umbilical vesicle*, with its omphalo-mesenteric (vitelline) duct, also fuses with the ventral stalk, so that the umbilical cord when fully formed consists developmentally of the following component parts: (1) the ventral stalk; (2) the umbilical blood-vessels from the primitive aorta; (3) the allantois; (4) the umbilical vesicle with its vitelline duct.

About the third month of gestation the vessels of the cord are four in number—two arteries and two veins; the latter afterwards fuse to form a single vessel, so that at term there are two arteries and one vein. Traces of the allantois, in the form of a small canal lined by cubical epithelium, may be found in the fœtal end of the cord up to term (fig. 24*a*). The umbilical vesicle soon disappears, but it is stated that a trace of it may sometimes be found at term in the form of a minute yellowish body at the placental insertion of the cord. The cœlom is also prolonged into the cord in the early months of gestation, and this condition may persist to term, giving rise to a congenital ventral hernia or *exomphalos*.

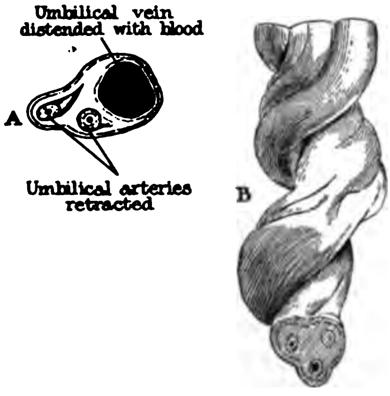
Umbilical vein distended with blood
A
Umbilical arteries retracted
B

FIG. 25.—THE UMBILICAL CORD AT TERM.

A. Transverse section showing vessels.
B. A portion showing torsion.

At term, the cord varies in length from 5 to 60 in. (10 to 120 cm.), the average being from 18 to 24 in. (45 to 60 cm.). The vessels are always twisted, the arteries usually encircling the vein from left to right; this torsion is evident as early as the third month, but the cause of it is unknown. The vessels are supported by a loose mucoid connective tissue called *Wharton's jelly*. This connective tissue is irregularly disposed round the vessels, giving

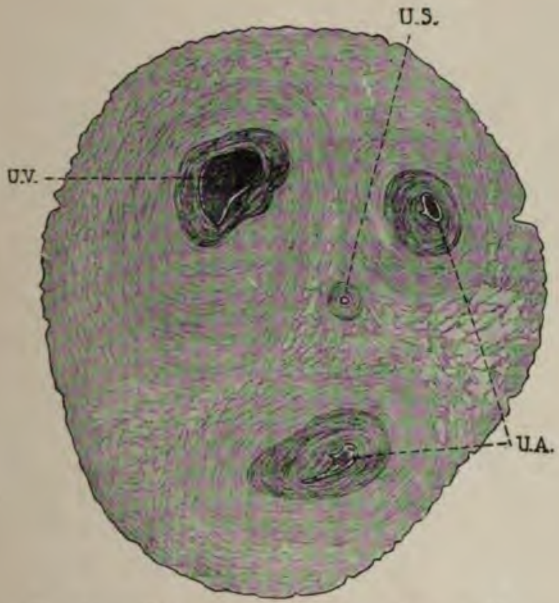

FIG. 24*a*.—UMBILICAL CORD, FŒTAL END. × 5½.
(WHITRIDGE WILLIAMS.)

U.A. Umbilical arteries. U.S. Remnant of allantois. U.V. Umbilical vein.

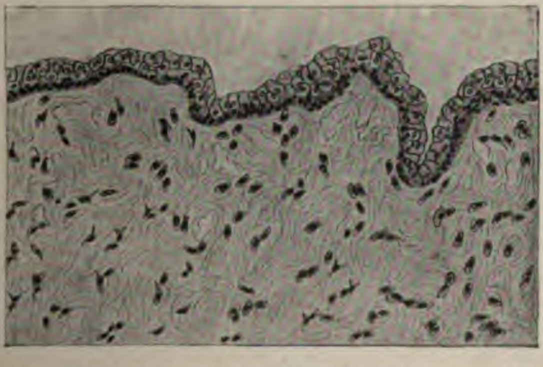

FIG. 24*b*.—EPITHELIUM OF UMBILICAL CORD. × 110.
(WHITRIDGE WILLIAMS.)

[*To face p.* 32.

rise, in places, to protuberances termed *false knots*, which at times, but not always, contain a loop of vessels. Sometimes a true knot is formed by the fœtus slipping through a loop of a very long cord *in utero* (fig. 26). This does not necessarily arrest the circulation through the cord. The epithelial covering of the cord consists at term of stratified cubical cells, resembling the fœtal epidermis (fig. 24*b*). It is generally believed that these cells are formed from a prolongation of the fœtal skin over the umbilical cord, and are not developed from the amnion.

The cord is usually attached to the centre of the placenta (*central insertion*); it may, however, be placed nearer the margin than the centre (*excentric insertion*) or upon the edge (*battledore insertion*), or it may be inserted upon the membranes outside the placenta (*velamentous insertion*) (see fig. 58). The fœtal insertion of the cord is not subject to variation. It will be noted that while its precursor, the ventral stalk, is attached to the caudal extremity, as the cœlom closes and the umbilical vesicle atrophies, the point of attachment is carried forward to about the centre of the body of the fœtus.

Fœtus.—During the first six weeks of its development the human embryo is indistinguishable, except by an expert embryologist, from that of other mammals or even birds. About the end of the second month it acquires definite characteristics which serve to distinguish it from others. It is usual to speak of the *embryo* during the first two months, and the *fœtus* later than that period.

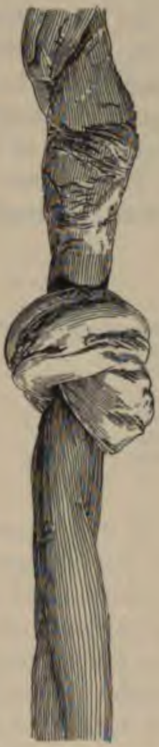
FIG. 26.—UMBILICAL CORD WITH TRUE KNOT. (CHARING CROSS HOSPITAL MUSEUM.)

A human embryo of the end of the first month, 10·5 mm. in length, is shown in fig. 27. It is markedly flexed, so that the cephalic and caudal extremities are almost in contact. The predominant size of the head and the caudal insertion of the umbilical cord will be noticed. An embryo from the end of the second month, 23 mm. = 1 inch in length, is shown in fig. 28. At this period the development of the limbs has considerably advanced, the fingers and toes being formed; the upper abdomen is protuberant owing to rapid growth of the liver; and the eyes, nose, mouth, and ears are formed. At the end of the third month the fœtus measures 7·5 to 9 cm. (3-3½ in.); the umbilical cord equals it in length and its vessels have become twisted; although the external sexual organs are undifferentiated, the sex may be established by examination of the internal organs.

The progress of the fœtus in length and weight during the succeeding months of gestation is as follows:

Period	Length	Weight
4th month (lunar) . .	10 to 17 cm. (4 to 6½ in.)	¼ lb.
5th „ „ . .	18 to 27 „ (7 to 10½ „)	½ „
6th „ „ . .	28 to 34 „ (11 to 13½ „)	1½ „
7th „ „ . .	35 to 38 „ (14 to 15 „)	2½ „
8th „ „ . .	39 to 41 „ (15½ to 16½ „)	3½ „
9th „ „ . .	42 to 44 „ (17 to 17½ „)	4¼ „
10th „ „ . .	50 to 53 „ (20 to 21 „)	7 to 7½ „

It will be seen that the rate of growth of the fœtus is not only very irregular from one month to another, but subject to considerable variations. A simple method of determining the period of development of the fœtus with sufficient accuracy for clinical purposes is that during the first five lunar months the length in centimetres is the square of the month; and during the second five months it is found by multiplying the number of the month by five. Thus the length at the end of the third month is 3 × 3 = 9 cm. (3½ inches), at the end of the seventh month 7 × 5 = 35 cm. (14 inches).

The Mature Fœtus.—Though subject to considerable variations, the average length of the fœtus at term is about 50 cm. (20 inches) and the average weight 7 to 7½ lb. Males are usually rather heavier than females. Weight is much more variable than length, for from various causes a mature fœtus may weigh much less than the average, while, from disease, a premature fœtus may equal it in weight. Healthy mature infants may weigh only 5 to 5½ lb., but any weight below this is probably to be attributed either to pre-maturity

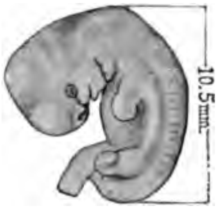

FIG. 27.—HUMAN EMBRYO OF FOURTH WEEK. (WHITRIDGE WILLIAMS.)

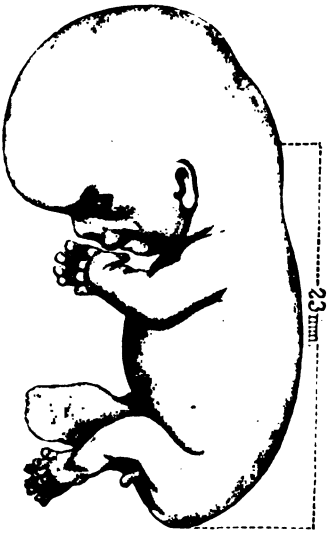

FIG. 28.—HUMAN EMBRYO OF END OF SECOND MONTH.
(WHITRIDGE WILLIAMS.)

[*To face p.* 34.

or to hereditary syphilitic taint. A fœtus weighing over 10 lb. is not rare; a weight of over 12 lb. is, however, very uncommon and is usually accounted for by post-maturity—*i.e.* undue prolongation of the period of gestation. The general differences between a premature and a mature fœtus may be tabulated as follows:

Seven months' Fœtus.	*Mature Fœtus.*
1. Skin lax, wrinkled, yellowish or dull red in colour, little vernix caseosa.	Skin smooth, plump, pink, covered with vernix caseosa.
2. Subcutaneous fat scanty.	Subcutaneous fat abundant.
3. Hair on scalp short, yellowish.	Abundant dark hair on scalp, 1 to 1¼ inch long.
4. Lanugo present over whole body.	Lanugo absent from most situations.
5. Short nails on fingers and toes.	Nails project beyond finger-tips.
6. Skull sutures open.	Skull sutures closed (*i.e.* bones in contact) except at fontanelles.
7. Moves and cries feebly when born.	Moves and cries vigorously when born

The Fœtal Circulation.—The umbilical vein, which brings purified arterial blood from the placenta, enters the trunk at the umbilicus and runs beneath the anterior abdominal wall to reach the lower surface of the liver (fig. 29, *vu.*). Here it gives off branches to the left lobe, the lobus quadratus and lobus Spigelii, which thus receive a direct supply of pure blood from the placenta. It then gives off another branch which joins the portal vein (*vp.*) as the latter is about to enter the right lobe; as the portal vein brings impure blood from the alimentary canal, the blood-supply of the right lobe of the liver is less pure than that of the other lobes. After giving off these branches to the liver, the umbilical vein, now reduced in size and called the *ductus venosus* (*dv.*), enters the inferior vena cava (*vci.*). Blood which has passed through the liver is carried by the hepatic veins (*vh.*) to the same great venous trunk, which now contains a mixed stream consisting of pure blood from the ductus venosus, and impure blood coming up from the lower extremities through the iliac veins, and from the liver through the hepatic veins. The blood brought up to the heart by the inferior vena cava is, however, still, comparatively speaking, pure, for the amount of impure blood carried into this vessel by the hepatic and iliac veins (lower extremities and pelvis) is relatively small.

The inferior vena cava enters the floor of the right auricle, and the blood-stream is immediately directed by the

Eustachian valve through the *foramen ovale* into the left auricle; thence it flows through the mitral valve into the left

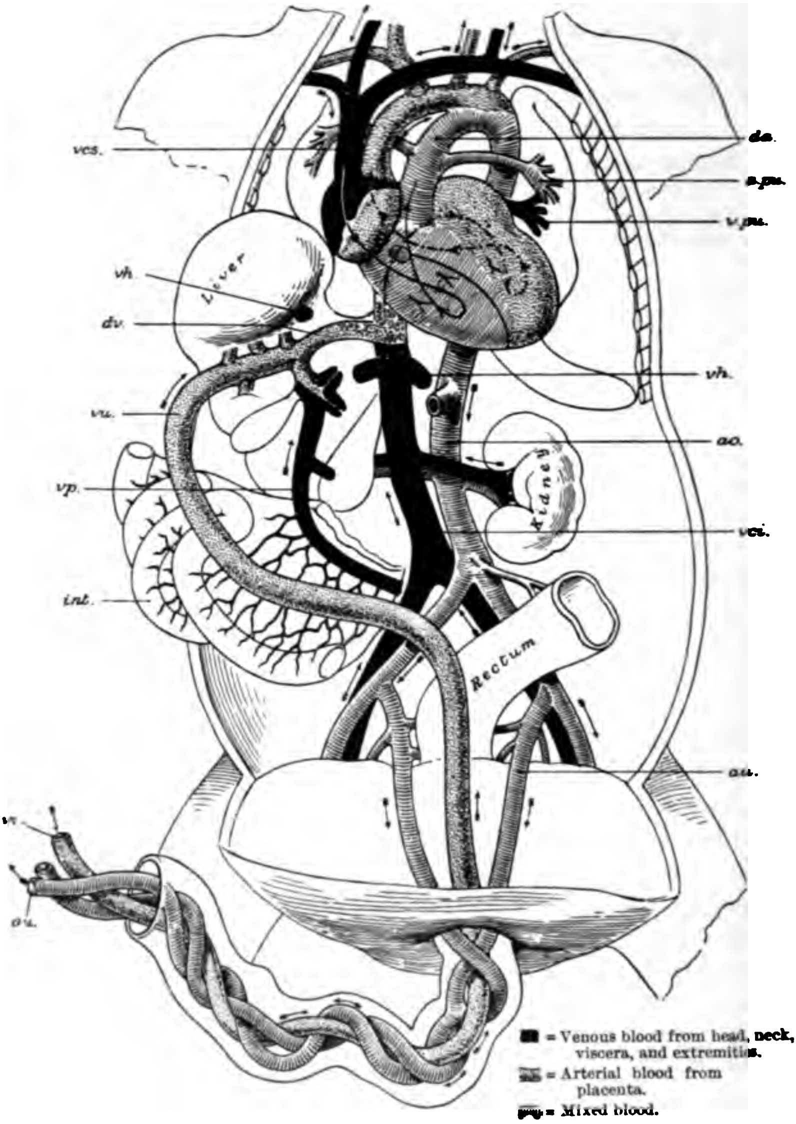
vcs.
vh
dv.
vu.
vp.
int.
vi.
au.
Liver
da.
a.pu.
v.pu.
vh.
ao.
Kidney
vci.
Rectum
au.
■ = Venous blood from head, neck, viscera, and extremities.
▨ = Arterial blood from placenta.
▤ = Mixed blood.

FIG. 29.—SCHEME OF THE FŒTAL CIRCULATION. (EDGAR.)

ventricle, and thence into the aorta. From the aorta branches pass to the head, neck, and upper extremities through the innominate, left carotid, and left subclavian trunks; excepting the liver, these parts therefore receive the purest supply of blood. From these parts the venous blood is returned to the right auricle by the superior vena cava (*vcs.*); thence it passes through the tricuspid valve to the right ventricle. There are therefore two blood-currents crossing one another in the right auricle, and it is believed that they are completely separated from one another by the Eustachian valve. From the right ventricle the blood passes into the pulmonary artery, which, after giving off branches to the lungs, passes on, as the *ductus arteriosus* (*da.*), to join the thoracic aorta near the origin of the left subclavian vein. The abdominal aorta (*ao.*) now contains a very mixed supply of blood consisting of a small amount of arterial blood from the placenta, which has passed from the right auricle through the Eustachian valve to the left side of the heart, and a large amount of venous blood from the lower extremities and pelvis (iliac veins), liver (hepatic veins), and head, neck, and upper extremities (ductus arteriosus). The aorta divides into the two iliac arteries; each of these in turn divides into (1) a hypogastric or umbilical artery (*au.*), giving off twigs to the pelvis, and then passing into the cord, and so to the placenta, and (2) an external iliac branch running to the lower limbs. The curious anomaly is thus presented that the arterial supply of the lower extremities is derived from the same trunk as the venous blood which is carried to the placenta to be purified. The blood carried to the placenta by the umbilical arteries passes through the villi, and is returned in a purified state to the fœtus through the umbilical vein (*vu.*).

Changes in the Fœtal Circulation at Birth.—These are due to two causes: (1) the expansion of the lungs by respiration; (2) the arrest of the placental circulation. The immediate effect of respiration is to divert a great part of the blood from the right ventricle to the lungs, and the ductus arteriosus accordingly becomes greatly contracted. The immediate effect of arresting the placental circulation is to reduce the pressure in the right auricle by diminishing the quantity of blood entering it through the inferior vena cava. At the same time the pressure in the left auricle is raised by the increased amount of blood returned to it from the lungs; the pressure in the two auricles is thus more or less equalised, diameter (fig. 31). It has now become large enough to fill the pelvic cavity, and in a primigravida (a woman pregnant for the first time) may be felt just above the level of the pubes on abdominal palpation. In a multipara it is often higher than this. At the end of the fourth month it has again become distinctly pyriform in shape (fig. 32); the vertical diameter is about 6 inches (15 cm.), and the fundus may be felt somewhat nearer the umbilicus than the pubes. The pyriform shape is henceforth preserved until term. Measurements of the height of the fundus above the pubes are somewhat fallacious, but at the end of the fifth month (twenty-two weeks) the uterus usually extends to the level of the umbilicus; at the end of the seventh month (thirty-one weeks) it is midway between the umbilicus and the tip of the xiphoid cartilage; the highest point is reached about ten to fourteen days before term, when the fundus extends to the tip of the xiphoid cartilage. It then sinks a little lower in the abdomen. The

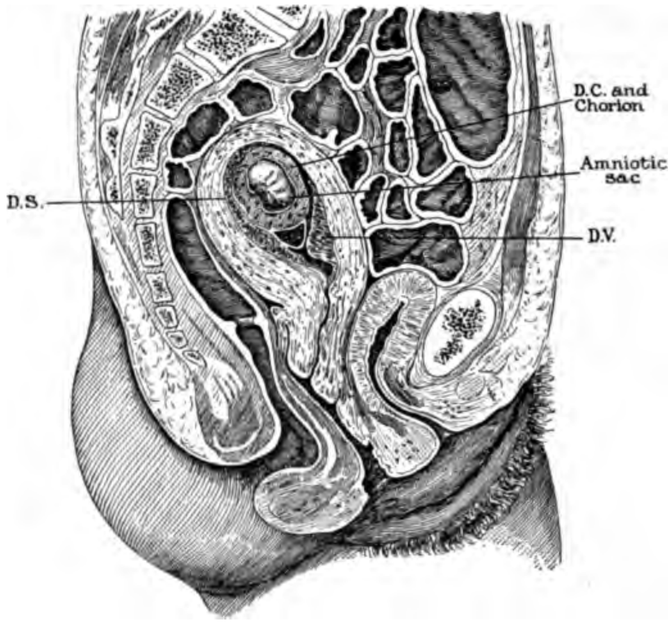

FIG. 30.—GRAVID UTERUS AT END OF SECOND MONTH. FROM A FROZEN SECTION. (BRAUNE.)

The uterus is retroverted, but shows the expansion of the body-cavity. D.C. Decidua capsularis. D.S. Decidua basalis (serotina). D.V. Decidua vera.

average height of the fundus above the pubes at term is about 10 to 12 inches (25 to 30 cm.), being a little greater in a multipara than in a primigravida: the widest transverse diameter of the uterus is 8½ to 9 inches (21 to 22 cm.). As seen in frozen sections, the uterus from the fifth month onwards is markedly moulded posteriorly upon the vertebral column (figs. 32 and 33).

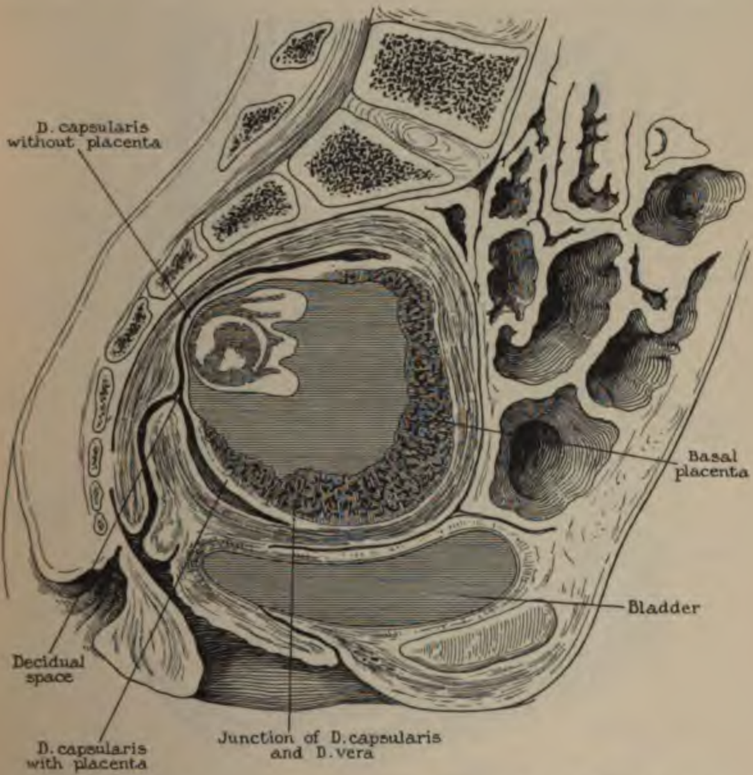
D. capsularis without placenta
Basal placenta
Bladder
Decidual space
D. capsularis with placenta
Junction of D. capsularis and D. vera

FIG. 31.—GRAVID UTERUS AT END OF THIRD MONTH. FROM A FROZEN SECTION. (CLARENCE WEBSTER.)

This specimen also illustrates the formation of placenta prævia.

During the first three months of pregnancy the ovum does not completely fill the uterine cavity (figs. 10, 30, and 31); a space persists in the lower part of the body of the uterus, known as the *decidual space* (see p. 27). During the fourth month the decidua vera and capsularis become closely apposed, obliterating this space, and bringing the ovum over the os internum (fig. 32); the same relation is thence maintained to term.

Changes in Relations.—The position of the gravid uterus after it has risen out of the pelvis is rarely precisely mesial; it is usually deflected to one or other side, more often to the right than the left. This is called the *lateral obliquity* of the uterus. It is also believed that rotation on a vertical axis occurs, bringing one or other—usually the left—cornu forwards towards the abdominal wall. This statement has not been supported by the study of frozen sections (Webster), and its accuracy is open to doubt. The normal position of anteversion

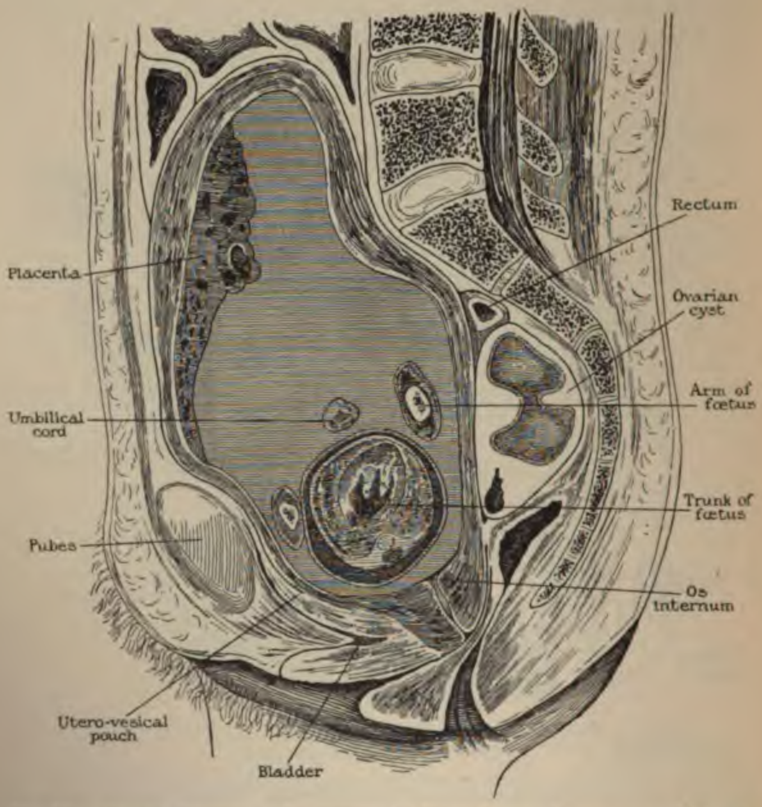

Fig. 32.—Gravid Uterus at Beginning of Fifth Month (Eighteenth Week). From a Frozen Section. (Clarence Webster.)

(tilting forwards) of the body of the uterus is often exaggerated during the first two months; afterwards the uterine axis becomes almost erect (fig. 32); later still the organ becomes moulded upon the vertebral column, and towards the end of pregnancy the tendency to anteversion again appears, especially in multiparæ with lax abdominal walls. These changes in the degree of anteversion produce corresponding variations in the position of the cervix which are appreciable to clinical examination. Thus, during the first two months the cervix is carried backwards by exaggerated anteversion of the fundus, until the external os is difficult to reach with the finger. Later on it becomes more central, and the os is easily reached. As term approaches the cervix again becomes displaced backwards, and it may be quite difficult to reach it when labour sets in.

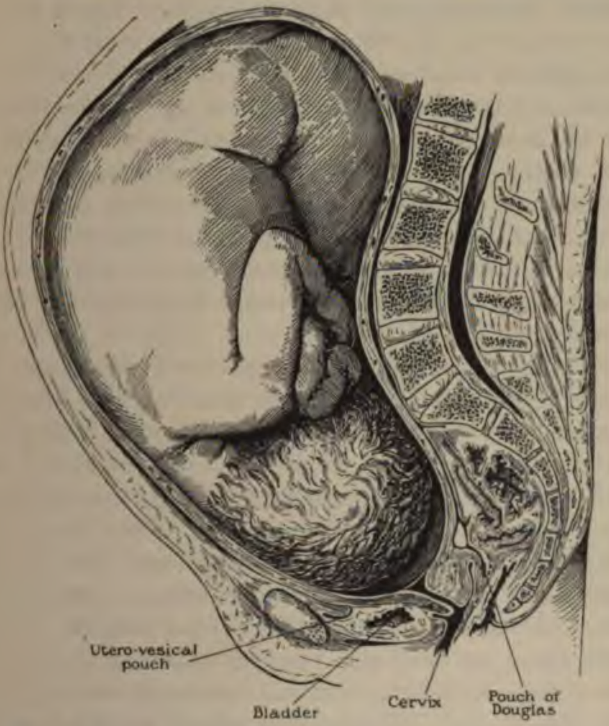

FIG. 33.—FROZEN SECTION OF GRAVID UTERUS AT TERM. (LEOPOLD.)

The relations of the uterus to its peritoneal investment undergo considerable changes. The uterine peritoneum develops *pari passu* with the growth of the uterus, and the anterior and posterior peritoneal pouches are preserved (figs. 32 and 33). The utero-sacral folds rise up to the level of the pelvic brim, and since the level of its floor remains unaltered, the pouch of Douglas at term is very deep indeed. The lateral reflections also rise considerably, so that at term the bases of the broad ligaments may be described as being at the level of the pelvic brim (Barbour); this leaves a large area of the lowest part of the uterine wall on each side uncovered by peritoneum. Considerable increase of connective tissue between the folds of the broad ligament, in relation to each lateral uterine wall, occurs during pregnancy. The round ligaments undergo considerable hypertrophy, so that they may in some circumstances be palpated through the abdominal walls. The bladder remains a pelvic organ up to term, and the level of the utero-vesical pouch is unaltered throughout pregnancy (fig. 33).

Changes in the Uterine Muscle.—The average thickness of the uterine wall at term is about half that of the non-pregnant organ, which is from ¾ to 1 inch (2 to 2·5 cm.), but there are variations in different parts. The posterior wall is fairly equal throughout; the anterior becomes thinner in its lower part before it joins the cervix. Both hypertrophy of existing muscle fibres, and new formation of muscle, occur in the gravid uterus. According to Kölliker, the muscle fibres in the second half of pregnancy are ten times as long and twice as broad as in the non-gravid state. New formation of muscle fibres only occurs during the first six months, and affects chiefly the deeper layers of the musculature. The fibres are said to become striated to some extent towards the close of pregnancy. During the course of pregnancy a more or less definite arrangement of the musculature of the body of the uterus into three layers occurs, but this change does not affect the cervix. The *outer* layer consists partly of longitudinal, partly of transverse fibres; the former are found in the form of a broad mesial band, running from the level of the ernal os in front over the fundus to the same level behind; latter cross the uterus in front and behind and pass out into the broad ligaments. The *middle* layer greatly exceeds either of the other two in thickness and is closely united with them; it forms a close reticulum of interlacing fibres, through which run the large arterial and venous channels; around the vessels it forms powerful rings of arcuate fibres arranged somewhat in the form of figures of 8. The *internal* layer is very thin, and is composed mostly of annular fibres, which encircle the whole uterus, and are specially developed at the cornua around the openings of the Fallopian tubes.

The Lower Uterine Segment.—It has been mentioned that the lower part of the anterior uterine wall becomes thinned for a short distance above the level of the internal os. Over this part the peritoneal coat is loosely attached and can be readily stripped off. It will be remembered that in the non-gravid uterus the peritoneum is loosely attached in the same position. Upon the posterior wall there is neither thinning of wall nor loose attachment of peritoneum. The part of the uterine body roughly corresponding to the area of loose peritoneal attachment is called the *lower uterine segment*. It was until recently believed that the lower segment could be *precisely* defined in this manner, but it now appears that the area of loose peritoneal attachment is subject to much greater variation than was formerly supposed (Barbour). Although only defined in this way upon the anterior wall, the lower uterine segment forms a complete zone. It is said that microscopically the arrangement of the bundles of muscle fibre is somewhat different in the lower segment from the remainder of the uterus (Barbour). Its special functions are connected with the process of labour, and the subject will be again referred to in that connection (see p. 189). The normal situation of the placenta is any part of the uterine wall above the lower segment; when the placental site encroaches upon this part of the uterus the condition of placenta prævia is produced. The development of the lower segment in pregnancy can be traced roughly by measuring the distance between the internal os and the level of firm peritoneal attachment: in this way it has been shown to increase from 2·3 cm. at the fourth month to 6 cm. at term. From what has been said of the relations of the peritoneum it will be perceived that at term the lateral aspects of the lower segment have no peritoneal investment, for they lie between the layers of the broad ligaments, the bases of which are greatly elevated.

The Cervix undergoes few alterations of importance during pregnancy. It preserves the naked-eye characters of its mucous membrane, which does not become transformed into decidua (fig. 10). It has recently been shown, however, that decidual cells may be found in the upper part of the cervical mucous membrane, and it is therefore probable that the changes characteristic of pregnancy do not end abruptly at the internal os, but may be traced in diminishing degree into the cervix (Aschoff). Its muscular coat does not hypertrophy, and it preserves the usual arrangement of its fibres in a dense network. Its relations to vaginal vault, cellular tissue, and peritoneum remain unaltered (see p. 43). It was formerly believed, from clinical observations, that the cervix became shortened during pregnancy; the study of frozen sections of the gravid uterus *in situ* has shown that the length of the canal is fairly constant and does not differ from that of the non-gravid organ (fig. 80). Clinically, however, a marked change occurs which is known as 'softening of the cervix.' It is found first at the lips of the os externum and gradually advances from below upwards until at term the whole of the portio vaginalis is softened. Although of great clinical importance, the histology of this change is obscure, and up to the present time no satisfactory study of it has been made. The surface of the portio vaginalis undergoes a variable degree of blue discoloration early in pregnancy, and as term approaches the internal os often becomes a little dilated in a multipara, occasionally in a primipara.

Uterine Contractions.—Throughout pregnancy the uterine muscle manifests a certain amount of activity. Intermittent contractions take place, feeble in the early months, but becoming more pronounced as the uterus develops, which bear a general resemblance to the uterine contractions, or 'pains,' of labour. They are intermittent and involuntary, but they differ from the contractions of labour in being painless—the patient is quite unconscious of them. Being palpable by abdominal examination, they form a clinical sign of great diagnostic importance in the later months of pregnancy. They are probably excited by some reflex mechanism, in which the ovum provides the peripheral stimulus; while the active hypertrophy of the uterine muscle makes the response to this stimulus very pronounced. Even when spontaneous contractions are imperceptible, hardening and contraction of the uterus can usually be induced by a gentle stimulus, such as rubbing with the hand.

The General Physiology of Pregnancy.

The presence of a developing ovum not only gives rise to important changes in the uterus, but affects to a remarkable degree the general functions of the body. The nature of the general physiological reaction to pregnancy is one of the most interesting problems in obstetrics; and although some progress has been made in its elucidation, the facts which have been elicited are not easy to interpret, and their practical significance is obscure.

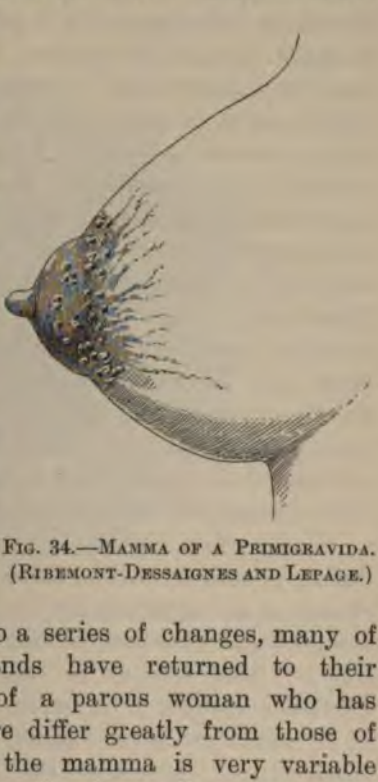

FIG. 34.—MAMMA OF A PRIMIGRAVIDA. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Mammary Glands. — These organs cannot be said to be fully developed until pregnancy has occurred, and has been followed by a period of lactation. In a primigravida (a woman in her first pregnancy) they undergo a series of changes, many of which persist after the glands have returned to their resting stage; the breasts of a parous woman who has suckled her children therefore differ greatly from those of a nullipara. The size of the mamma is very variable in healthy women, as are also the size and appearance of the nipple and areola. In a first pregnancy the whole gland increases in size, and undergoes a true hypertrophy, which affects not only the glandular acini, but also the connective-tissue stroma (fig. 34). This hypertrophy is first recognisable clinically in the peripheral lobules of the gland, which become tense, nodular, and slightly tender to the touch. It usually appears at about the end of the second month, although it may be delayed until the fourth month. When the hypertrophy of the lobules is well marked, a little clear pale-yellow secretion can usually be expressed by gently compressing the base of the gland and squeezing it towards the nipple. The nipple and areola become more deeply pigmented, but this change varies much in women of different complexion, being more marked in brunettes than in blondes. Upon the areola a series of ten to twenty small non-pigmented nodules appear, consisting of enlarged sebaceous glands, and known as 'Montgomery's tubercles' (fig. 35); they are not, however, invariably present. Usually the areola becomes more prominent than normal, and around it is formed an outer zone of irregular and less marked pigmentation, known as the *secondary areola*. As shown in fig. 35, the secondary areola usually consists of a well-defined reticulum, forming a tessellated arrangement of pale quadrilateral areas enclosed in a deeply pigmented web. An increased vascular supply, indicated by dilated venules under the skin, accompanies the hypertrophy. Often towards the close of a first pregnancy the skin itself becomes stretched, and small patches of the cutis vera becoming thinned, give rise to the appearances known as *striæ* (see p. 50). The secretion varies in character during pregnancy; when first seen it is usually a thin straw-coloured fluid resembling serum; later it becomes thicker, more opaque, and more distinctly yellow in colour.

Vagina and Vulva. The vaginal walls become softened during pregnancy in the same manner as the cervix, but the change is not apparent until a later period. Hypertrophy of the muscular coat is also said to occur, although the process has not been studied in the same detail as in the uterus. Clinical evidence of increased vascularity can also be found in (1) pulsation in the vaginal arteries; (2) the formation of small varices, especially near the vulva; (3) purple discoloration of the mucous membrane, which is most obvious at the ostium vaginae, but also affects the surface of the portio vaginalis cervicis and the vulva. There is usually some increase of pigmentation of the labia minora, and in dark-complexioned women these parts may become very deeply pigmented.

The vaginal secretion is of great physiological importance in pregnancy, and its bacteriological characters have been

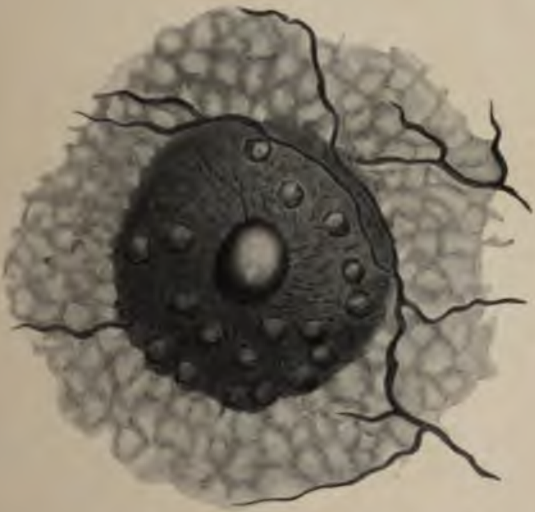

FIG. 35.—THE NIPPLE AND AREOLA OF A PRIMIGRAVIDA, SHOWING THE TUBERCLES OF MONTGOMERY, THE SECONDARY AREOLA, AND SEVERAL DILATED VEINS.

[*To face p.* 48.

studied with care. In a healthy pregnant woman it is abundant, and occurs as a whitish, flaky, semi-solid material, not unlike smegma in appearance; it is acid in reaction and contains nearly pure cultures of an organism known as the *vaginal bacillus* (Döderlein). The acid reaction is due to the presence of lactic acid, which is one of the products of growth of this organism. Often the vaginal secretion is different from this, being thinner, more yellowish, and less definitely acid in reaction. This variety of secretion, described by Döderlein as 'abnormal,' may contain various species of micro-organisms, but probably none are pathogenic except in cases of local disease. The acid secretion, described by Döderlein as 'normal,' possesses definite bactericidal properties, for streptococci introduced into the vagina experimentally are all destroyed by it in from twenty-four to forty-eight hours. This property is attributed to the activity of the vaginal bacillus. Whether the secretion can destroy all kinds of pathogenic organisms we do not know; enough is, however, known to show that the vaginal secretion of a healthy pregnant woman forms a natural defence against the invasion of the genital tract by micro-organisms coming in from without.

Circulatory System.—The *blood* undergoes modifications which are fairly constant, and upon which observers are agreed. In animals the total volume of the blood is increased during pregnancy, and the same change can fairly be assumed to occur in women. The quality of the blood, however, deteriorates, for the proportion of water increases, while the proportions of red cells and hæmoglobin diminish; these evidences of anæmia are most marked about the middle of pregnancy, but even at term the average number of red cells is under 4,000,000 per c.mm. A slight absolute leucocytosis, affecting all varieties of white corpuscles, also exists throughout pregnancy. The specific gravity is progressively diminished up to the middle of pregnancy, and rises again to normal at term. The amount of fibrin diminishes up to the sixth month, when it begins to rise again to normal at term. It will thus be seen that deterioration in the quality of the blood is evident during the first half of pregnancy, but has to a great extent disappeared at term.

The *heart* was for a long time believed to undergo hypertrophy during pregnancy. There has been much conflict of observation upon the point, but Löhlein asserts that the weight of the organ is not appreciably increased, and therefore there can be no hypertrophy. A certain amount of dilatation probably occurs, affecting chiefly the right side of the organ. *Arterial tension* is believed to be increased slightly during pregnancy, but it is very variable, and clinical observations have failed to settle the question definitely. Evidence has recently been produced that there is a slight but progressive rise of *blood pressure* during the latter half of pregnancy, which reaches its height during the second stage of labour; after this a marked fall occurs. In the *venous system* evidences of increased back-pressure are frequently found in the appearance of hæmorrhoids, vulval varices, and slight anasarca of the feet, with a varicose condition of the veins of the lower limbs.

Cutaneous System.—In addition to the changes which occur in the mammary glands and vulva, the skin of the abdominal wall always, and of the face sometimes, undergoes remarkable changes. On the *anterior abdominal wall* a mesial line of pigmentation, called the *linea nigra*, usually appears in the second half of pregnancy, running from above the umbilicus down to the pubes; the umbilicus also becomes more or less deeply pigmented. The degree of discoloration varies with the complexion, just as do the areolar changes in the breasts: in a dark-complexioned woman the line may be broad and very dark brown in colour; in a fair woman it will be barely visible. Sometimes a faint linea nigra can be seen in a non-pregnant woman, so that it is not pathognomonic of pregnancy. As the abdomen becomes distended by the growing uterus, *striæ gravidarum* appear on the abdominal wall similar to those formed on the breasts. They are pearly or pinkish in colour when recent, linear in outline, vary much in length and breadth, and are most marked below the umbilicus, but may extend over the adjacent parts of the thighs and buttocks (fig. 36). After labour is over they become pale and silvery (*striæ albicantes*). In a multipara some are pink and others pale, the latter representing the changes which have occurred during a previous pregnancy. A small number of similar striæ are not infrequently seen in abdominal distension due to causes other than pregnancy. As pregnancy advances the umbilical depression is gradually obliterated, and at term the navel lies flush with the abdominal surface.

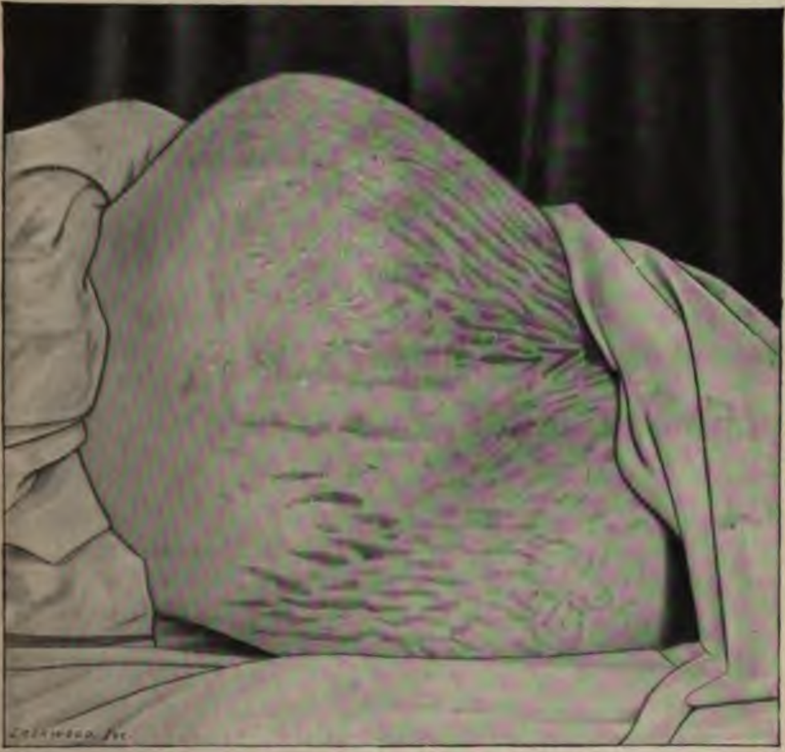

FIG. 36.—ABDOMEN OF A PRIMIGRAVIDA AT TERM, SHOWING RECENT STRIÆ GRAVIDARUM. (WHITRIDGE WILLIAMS.)

[*To face p.* 50.

On the *face* irregular patches of dark-brown pigmentation sometimes occur, termed the 'pregnancy mark' or *chloasma*. This pigmentation is most marked on the forehead, sides of the nose, and upper lip, but may involve the whole of the face; it disappears after labour.

Towards the close of pregnancy slight anasarca is frequently to be observed in the lower extremities, and over the abdomen below the level of the navel; it probably results from interference with the venous return from these parts by compression of the great veins of the trunk by the large uterus. An extreme degree of this condition often accompanies albuminuria in pregnancy (see p. 79).

Excretory Functions.—It has been known for a long time that the amount of carbonic acid thrown off by the lungs is distinctly increased during pregnancy. Observations upon the functions of the skin have not been made, but great attention has of late years been paid to the condition of the urine, and the following facts have been established. The daily quantity of urine is frequently below the average in primiparæ. The proportion of total solids diminishes steadily up to term, the fall being due to diminution in the amounts of uric acid, urea, phosphates, sulphates, creatin, and creatinin. The chlorides, on the other hand, are increased, but we do not know the significance of this increase. A fair average excretion of urea for a pregnant woman on an ordinary mixed diet is estimated at 1·25 per cent. Of the total nitrogen excretion the proportion excreted as urea is normal, but the proportion excreted as ammonia is slightly increased. A study of the nitrogen intake and output has shown that towards the end of pregnancy the mother is storing nitrogen at a rate considerably in excess of the nitrogenous requirements of the fœtus, which are estimated at one grain a day. Sometimes sugar is found in the urine of healthy pregnant women towards term, and this has been shown to be due, in most cases, to lactose derived from the abundant mammary secretion, although alimentary glycosuria may also occur. Lactose is also very frequently found in the urine of nursing women. It will be observed that the solid constituents of the urine which are diminished are chiefly those produced by the liver —urea, uric acid, creatin, creatinin—and disturbance of the functions of that organ is probably the cause of this alteration.

Attention has recently been directed to the investigation of the toxicity of the urine in pregnancy. The methods employed are necessarily somewhat complex, and they cannot be described here in detail; but it may be said briefly that they consist in determining the amount of urine which will produce death when injected directly into the vein of an animal, usually a rabbit or guinea-pig. This is called the *urotoxic dose*, and it can be compared with the urotoxic dose of the urine of a healthy non-pregnant woman, which is taken as the standard. If the urotoxic dose is larger in the pregnant than in the non-pregnant, then the toxicity of the urine is less, and *vice versa*. Contradictory results have been obtained by this method, and extreme care is required in conducting the observations; a majority of observers, however, assert that a slight diminution in the toxicity of the urine can be detected from the end of the second month up to term, but it rapidly disappears after labour. From this basis a theory has been built up that a toxic condition of the blood exists in normal pregnancy, for if less toxic matter is excreted it must be assumed to accumulate in the blood; and this is called *toxæmia of pregnancy*. Confirmation of the theory has been sought by making observations in a similar manner upon the toxicity of the blood-serum of pregnant women; but the results of these observations are of very little value, owing to difficulties of experimental technique. It is, however, obvious that if an increase in the toxicity of the blood could be experimentally proved to occur during pregnancy, the existence of a condition of 'toxæmia' could not be denied. For the present it must be said that the existence of a toxic condition of the blood in *normal* pregnancy has not been proved; but, as we shall see later, these observations have been of great service in throwing light upon the causation of some of the disorders of pregnancy.

Other Organs.—In a certain number of cases the *thyroid gland* has been observed to enlarge during pregnancy, but there is no evidence that this usually occurs, nor do we know its significance. The *nervous system* becomes functionally disturbed in women of neurotic tendencies, and such conditions are manifested as irritability, sleeplessness or constant drowsiness, neuralgia, perversion of appetite by the so-called 'longings,' &c. But in women whose nervous system is in a state of stable equilibrium these disturbances of function do not occur. Towards the end of pregnancy the size of the uterus causes some embarrassment of respiration, which becomes almost entirely costal in type; and cramps in the muscles of the legs are frequent from pressure upon the lumbar and sacral plexuses. The *bladder* usually shows some irritability about the second month, but this passes off and does not recur until the close of pregnancy, when micturition again not uncommonly becomes frequent and painful. *Nausea and vomiting* are usually present in the early months (see Morning Sickness, p. 55), and there is a common tendency to constipation and the formation or aggravation of hæmorrhoids. A slight decrease in the total acidity of the gastric secretion and in the amount of free hydrochloric acid accompanies pregnancy. The *pelvic articulations* undergo slight softening of ligaments and general loss of firmness and strength during pregnancy.

The Diagnosis of Pregnancy

The limits of age within which pregnancy may occur are very wide. It is rare before puberty, and even more rare after the menopause. Yet authentic instances of pregnancy have been observed at the age of eight or nine years in girls in whom menstruation had appeared abnormally early. And one or two authentic cases have also been recorded after the menopause, one of these being a woman of fifty-nine who had ceased to menstruate for nine years (Depasse). It may, however, be said that pregnancy is extremely uncommon before thirteen and after fifty.

The nomenclature of the duration of pregnancy is somewhat confusing. In this country it is usual to speak of nine calendar months as the period of gestation, but this is inexact. It is agreed that the average duration of pregnancy is from 274 to 280 days; neither of these periods represents precisely nine months, for the number of days in nine months is variable, but the latter does represent exactly ten times four weeks—*i.e.* ten 'lunar' months. It would avoid confusion to estimate the duration of pregnancy in weeks instead of months.

During the later months of pregnancy the presence of a fœtus in the uterus can be directly recognised by palpation and auscultation. During the earlier months this is impossible, and diagnosis then depends upon the careful observation of a certain series of *symptoms* (facts elicited from the patient), and *physical signs* (facts observed by the physician). The practical value of being able to recognise pregnancy at all periods is very great, and the subject therefore demands the most careful attention.

I. Diagnosis of Pregnancy during the First Half.—Symptoms.—Those met with during this period are amenorrhœa, morning sickness, irritability of the bladder, discomfort and swelling of the breasts, enlargement of the abdomen, and 'quickening.' It must be understood that not one of these symptoms occurring alone, nor even all of them occurring together, can be regarded as conclusive evidence of pregnancy. They allow of the 'presumptive diagnosis' of pregnancy, but a final opinion should never be expressed in any case until a physical examination has been made.

Amenorrhœa.—Cessation of the menses is practically invariable in pregnancy; cases are said to occur in which regular menstruation continues for the first two or three months, but no well-authenticated modern instances are on record. Irregular hæmorrhage from pathological causes is not uncommon in pregnant women, but this should not be confounded with menstruation. Sudden cessation of the menses in a healthy woman habitually regular, and not near the age of the menopause, affords a strong presumption of pregnancy. Amenorrhœa usually, though by no means invariably, continues during suckling, and it is also common in chlorosis, in hysteria, and in some forms of insanity. The latter conditions need not be mistaken for pregnancy. In addition to its value as a presumptive symptom of the existence of pregnancy, amenorrhœa affords the best means of estimating its duration. It is usual to reckon the commencement of pregnancy from the last day of the last regular menstrual period. This method is certainly fallacious, for pregnancy may occur during a period of amenorrhœa due to some other cause, such as suckling, and it takes no account of the fact that the date of fruitful sexual intercourse may not correspond with the cessation of menstruation, but it is the best method which is available for the purpose. Sometimes, however, the duration of pregnancy must be estimated from other data, such as the size of the uterus.

It is not known why the presence of a developing ovum in the uterus causes the immediate arrest of menstruation. There is a certain amount of evidence that ovulation continues, or may continue, during pregnancy (see Superfœtation, p. 67), therefore the explanation is probably to be sought in some functional alteration in the innervation of the uterus. After the fourth month, when the decidual space has been obliterated, of course menstruation cannot occur, for the uterine mucous membrane has practically ceased to exist, except as a part of the placenta.

Morning Sickness.—This symptom is by no means invariable in pregnancy. The great majority of primigravidæ suffer from it, but in subsequent pregnancies it is frequently absent. It usually appears at the beginning of the second month—*i.e.* soon after the first suppressed period—and varies greatly in severity. Some pregnant women are seized with nausea, ending in vomiting, immediately on rising or after their first meal; the vomiting once over, there is no further discomfort nor any loss of appetite during the rest of the day. Others are subject to nausea, without vomiting, which may last for several hours and is more troublesome than the first-named variety. But in neither case is the general health affected, and the tongue remains clean. All gradations may be observed between this symptom and the serious disorder of pregnancy known as hyperemesis or pernicious vomiting (see p. 87). Morning sickness in either of these common forms usually lasts for only a few weeks, rarely for more than three months. Much fruitless speculation upon its causation has been indulged in. It must be remembered that in chronic alcoholism morning sickness, sometimes associated with amenorrhœa and abdominal enlargement, may be met with apart from pregnancy; but the tongue is furred, and the careful observer will detect other changes characteristic of this condition.

Irritability of the bladder, shown by frequency of micturition with some pain or discomfort, is usual during the second and third months, and is no doubt caused by the pressure of the heavy anteverted uterus. After the third month, when the uterus rises above the pelvic brim and becomes more erect, the pressure is removed, and this symptom disappears.

Enlargement of the breasts is often noticed early by a primigravida, but *enlargement of the abdomen* usually does not become manifest to the patient until the uterus rises up to the umbilicus, and therefore seldom attracts attention until the close of the first half of pregnancy. A multipara, owing to the laxity of the abdominal wall, usually notices abdominal enlargement earlier than a primigravida.

Quickening.—This term in its ancient significance means 'coming to life,' and indicates that the mother has become aware of the existence of life within her. The first movements of the fœtus which are felt by the mother sometimes produce a sensation of more or less severe nausea or faintness, and to this symptom the term 'quickening' is applied. Many women do not experience it, and find it impossible to tell when the movements of the fœtus first became obvious to them, so gradual has been their development. When a definite history can be obtained, quickening is usually found to occur between the sixteenth and eighteenth weeks.

Physical Signs.—During the first four weeks no changes occur which can be detected by clinical investigation, and unless the conditions are specially favourable the earliest period at which pregnancy can be diagnosed is the sixth or eighth week. We therefore take up the physical signs at the latter period.

Eighth Week.—At this period the breasts of a primigravida may present recognisable indications of activity, but frequently they show no change until the following month. Some hypertrophy of the peripheral lobules of the glands, indicated by a nodular feel and slight tenderness, may be apparent, while the areolar changes described on page 48 may also be detected. Occasionally a little clear serum may be expressed by gently squeezing the base of the gland towards the nipple. In the case of a multipara no importance can be attached to the existence of any of these signs, as they frequently persist in a gland which has previously passed through the period of functional activity associated with suckling, or even with pregnancy alone. Secretion is also sometimes found in the breasts of non-pregnant nulliparous women suffering from uterine disease, such as a fibroid tumour.

Examination of the abdomen at this period is of no value, but *changes in the uterus* may be detected by a careful bi-manual examination. Softening of the lips of the os externum may be made out, but is not very marked, and may be mistaken by the student for the condition clinically known as 'erosion'; examination with a speculum will clear up this difficulty, unless erosion of the cervix and pregnancy co-exist. If the abdominal wall is thin and lax, the body of the uterus can be taken between the fingers of the two hands, and its increased size, almost globular shape, and soft consistence detected. Another important change known as *Hegar's sign* must also be looked for.

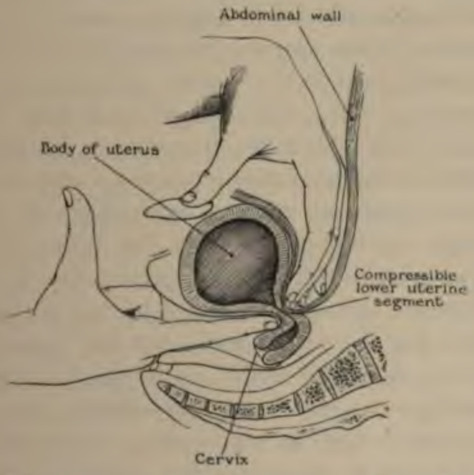

FIG. 37.—SCHEMATIC REPRESENTATION OF HEGAR'S SIGN. (AFTER HEGAR.)

Hegar's sign is the result of certain anatomical conditions which are characteristic of the second and third months of pregnancy. It will be recollected that at this period the ovum does not completely occupy the uterine cavity, an empty space being left in the lower part, called the decidual space. At this period also the walls of the uterus have become distinctly softened, and perhaps somewhat thinned. The body of the uterus is therefore in its upper part soft and distended by the ovum, in its lower part soft and empty. The lower part is consequently unusually compressible by the fingers in bi-manual examination, and Hegar's sign consists in the recognition of this unusual degree of compressibility. To obtain it, the uterus should be anteverted, although even in the retroverted position it can be elicited in a modified manner. Bi-manual examination is made with the patient lying on her back, the shoulders slightly raised, and the knees well flexed. Two fingers of the right hand are introduced into the vagina and placed immediately in front of the cervix; the left hand is placed over the suprapubic region. The uterus is then pushed upwards from the vagina towards the abdominal wall until it can be distinctly felt by the left hand. The fingers of the left hand are now passed over the posterior surface of the uterus, and when the two hands work together the lower part of the uterine body can be compressed between them (fig. 37). Two points will then be noticed: first, the ease with which the fingers can be approximated and the walls of the uterus compressed; and secondly, the tense elastic consistence of the upper part of the uterus, which forms a marked contrast to the lower part. When the uterus is retroverted, the compressibility of the lower part can be made out with a finger in the rectum and the other hand on the abdominal wall; but the upper part of the body is not so easily accessible as in the position of anteversion, consequently the contrast between the upper and lower parts cannot well be made out. A certain amount of skill and experience in gynæcological examination is necessary for the recognition of this sign, but its value is very great when clearly perceived.

To sum up, it may be said that pregnancy at the eighth week can be diagnosed from the conjunction of the following series of symptoms and physical signs:

Symptoms	*Signs*
1. Amenorrhœa.	1. Lips of os externum softened.
2. Morning sickness.	2. Uterus enlarged, softened, somewhat globular in shape.
3. Irritability of bladder.	3. Hegar's sign.
	4. Slight breast changes (in a primigravida).

Sixteenth Week.—Amenorrhœa continues, but morning sickness and urinary symptoms have usually disappeared by this time. It is about this period that quickening is to be expected. The enlargement of the breasts has become quite obvious to the patient if she is a primigravida, but abdominal enlargement may not yet have attracted her attention.

Hypertrophy, increased pigmentation, and presence of secretion in the breasts can now, as a general rule, be made out. The linea nigra will be quite obvious in dark-complexioned women. The uterus is large enough to be felt rising to a height of about three inches above the level of the symphysis pubis. It forms an elastic, somewhat ill-defined, mesial abdominal swelling, with a convex upper border. The characteristic dull violet coloration of the vulval mucous membrane is now recognisable, but its extent and intensity are variable. The cervix shows more extensive softening, and at this period forms one of the most characteristic and easily recognisable features of pregnancy. If exposed with a speculum the same violet coloration will be noticed as at the vulva. Pulsating vessels can often be felt at the sides of and behind the cervix—the enlarged vaginal arteries. The abdominal swelling can be recognised as the uterus by bi-manual examination; its shape is now passing from globular to pyriform; its consistence is intermediate between the hardness of a solid mass and the lax softness of a cyst, and is usually described as 'elastic'; but some experience is required to detect with confidence these varieties of consistence. Hegar's sign can no longer be made out. Two other signs of great importance can often be recognised at this period in the uterus—viz. *uterine contractions* and *internal ballottement.*

The fact that the gravid uterus undergoes *contractions* has been already referred to; they are not recognisable clinically much earlier than the period under consideration, but it is possible that they exist in some form from the beginning of pregnancy. They are feeble contractions, and as detected at the end of the fourth month they merely render the uterus a little firmer and better defined in outline. Care and a prolonged *bi-manual* examination are required for their detection, for the intervals between them may be considerable; they sometimes appear to be increased by manipulating the uterus. The contractions are often unequal, causing some distortion of the uterus. If the abdominal wall is thick or rigid, or the patient intolerant of the examination, this sign cannot be made out, and no importance must be attached to a failure to elicit it; but its positive value is considerable. It sometimes occurs, however, apart from pregnancy, in soft fibroid tumours, and has been recognised in the enlarged uterus in cases of extra-uterine gestation.

Internal ballottement consists in the detection in the uterus of a movable solid body surrounded by fluid. If during a bi-manual examination the fœtus should chance to lie upon the lower anterior uterine wall, the fingers, sharply pressed into the anterior fornix will displace it upwards through the amniotic fluid, and the sensation of its disappearance will be felt; if the fingers are kept in position a slight impact may be felt a moment later, indicating its return to its original position. The recoil is often missed, but the displacement of the fœtus can frequently be detected. The fœtus, however, often occupies a position where it is out of reach of the fingers on vaginal examination, and this sign cannot then be elicited. It is more easily obtained in the erect than in the supine position. It will be remembered that at this period the size of the fœtus is small in comparison with that of the uterus.

Pregnancy at the sixteenth week can therefore be diagnosed from the following:

Symptoms	*Signs*
1. Amenorrhœa.	1. Active breast changes.
2. Quickening.	2. Linea nigra; elastic hypogastric swelling (uterus).
3. History of recent morning sickness.	3. Cervix softened.
	4. Uterine contractions, internal ballottement.

II. Diagnosis of Pregnancy during the Second Half.—Symptoms.—The symptoms during the second half of pregnancy are of little diagnostic importance, since unmistakable evidence is furnished by the physical signs. Amenorrhœa continues; a good deal of mammary discomfort is often experienced by a primigravida, owing chiefly to the increased weight of the enlarged glands. Towards the end of this period symptoms of intra-abdominal pressure appear, such as œdema of the feet and cramps in the lower extremities, varicose veins in the legs and vulva, and sometimes, from upward pressure on the diaphragm, palpitations and dyspnœa. About fourteen days before the onset of labour these symptoms all undergo a somewhat abrupt amelioration, popularly known as the 'lightening'; this is due to descent of the presenting part of the fœtus into the pelvic brim, and consequent relief of abdominal pressure.

Physical Signs.—*Twenty-sixth Week* (*end of Sixth Calendar Month*).—Hypertrophy of the mammæ is now unmistakable; secretion can be freely expressed; pigmentary areolar changes have become intensified.

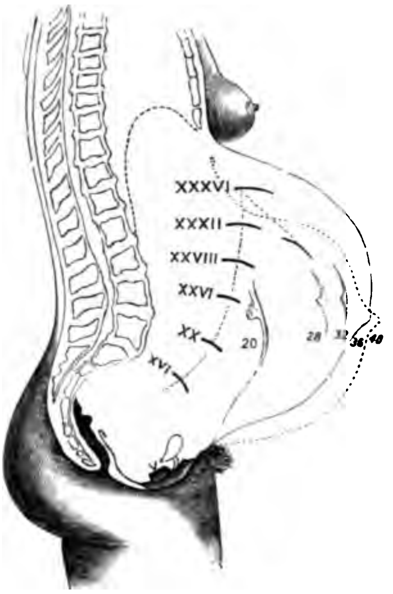

FIG. 38.—SCHEMATIC REPRESENTATION OF THE HEIGHT OF THE FUNDUS AND THE SHAPE OF THE ABDOMEN IN PREGNANCY. (ROBERTS.)

The figures indicate weeks.

Abdomen.—Protuberance of the lower half of the abdomen is now clearly visible, and a few recent striæ may be observed below the level of the umbilicus; the linea nigra in dark women is pronounced. On palpation the fundus of the uterus will be found at the level of the upper border of the umbilicus (fig. 38). The uterus is distinctly pyriform in shape, and usually extends further to the right than to the left of the mesial plane — *right lateral obliquity*. Occasionally the obliquity is to the left, but the uterus is seldom exactly mesial. Its general consistence is elastic, but it does not yield a fluid thrill. Contractions can usually be felt when it is gently palpated with the hands for two or three minutes. From the period when the fundus becomes palpable above the pubes, it rises, when developing normally, about half an inch a week.

In addition certain other signs may be detected on abdominal examination which are not found at earlier periods; these are, on palpation, *external ballottement* and *spontaneous* *fœtal movements*; and on auscultation the *uterine souffle* and the *fœtal heart-sounds.* Palpation of fœtal movements and auscultation of the fœtal heart are positive or absolute signs of the presence of a living fœtus, and their detection renders the diagnosis of pregnancy not a probability, but a certainty.

At the twenty-sixth week, the fœtus, though large enough to be readily felt on abdominal palpation, moves freely, for it is still small in comparison with the size of the uterine cavity. The palms of both hands should be gently laid over the uterus, and while one hand is used to steady it, the fingers of the other hand make a series of quick but gentle impacts upon it; the whole anterior surface of the uterus is gone over in this way. At some part or other the fingers will come down upon the body or a limb of the fœtus; the latter immediately recedes before the impact, but gives a distinct momentary sense of contact with a freely movable body. This is called *external ballottement.* Sometimes the fœtus can be displaced in this way across the uterus, and thus, as it were, tossed from one hand to the other. While using the hands in this manner, *spontaneous movement* of some part of the fœtus—probably a limb—will often be detected, proving not only that there is a fœtus present, but that it is alive. Care is required in eliciting these signs, but their diagnostic value is absolute.

Uterine Souffle.—From the middle of pregnancy onwards, a soft, blowing, systolic murmur, synchronous with the mother's pulse, can usually be heard on auscultation of the gravid uterus. It is best heard at the lowest part of the lateral borders, but may sometimes be loud enough to be audible all over the anterior surface of the uterus. In seeking this sign the uterus should be steadied with one hand and the stethoscope pressed firmly upon it; while listening to the sound the mother's pulse, with which it is synchronous, should be felt at the wrist. There is some dispute as to the causation of the uterine souffle, but in all probability it is produced in the greatly enlarged uterine arteries, which, it will be remembered, reach the lateral borders of the organ from the broad ligaments at the level of the internal os. Some authorities believe that it is produced in the large vessels of the placental site, and that, accordingly, the part of the uterus over which the sound is loudest is to be regarded as the placental site.

Apart from pregnancy, it may be heard in cases of fibroid tumours of the uterus.

Fœtal Heart.—The recognition of the sounds of the fœtal heart is the most conclusive of all the signs of pregnancy; not only is it important in diagnosis, but during labour it affords valuable information, and the student should lose no opportunity of becoming familiar with it. The fœtal heart can usually be heard by the twenty-sixth week, but the further pregnancy advances beyond this, the more easily it is detected. Its localisation at this period is variable, and the whole anterior surface of the uterus must often be carefully searched before it can be found. Some experience in auscultation is of course necessary; but if opportunities of learning this sign in pregnant women at term have been previously made use of, its recognition at this period of pregnancy will be greatly facilitated. At the sixth month the fœtal heart-sounds resemble the feeble or distant ticking of a watch; they are much more rapid than the beats of the mother's pulse, which should always be simultaneously counted as a control, and they differ absolutely in character from the uterine souffle. It is essential that a definite difference in rate between the maternal pulse and what is taken for the fœtal heart should be clearly made out, for sounds may be transmitted from the aorta which will be misunderstood unless this precaution be taken. At the sixth month the fœtal heart beats from 140 to 160 times a minute, and it is therefore difficult to count. *At term* the average rate is from 120 to 140, but even wider limits than these are possible; only when the rate falls below 100, or rises above 180, can it be said to indicate danger to the fœtus. The fœtal heart-rate is not a reliable indication of sex, but it is found, as a rule, that the larger the fœtus the slower is the rate; and as male are usually larger than female fœtuses, the slower rates may be taken to indicate the former.

In connection with the fœtal heart-sounds the *funic souffle* must be mentioned. It sometimes happens in auscultating the gravid uterus that a loop of the umbilical cord lies immediately beneath the bell of the stethoscope, and, being subjected to slight compression, either by its position in the uterus or by the instrument, a faint rapid blowing murmur is produced, which is synchronous with the fœtal heart-sounds. It is seldom detected, and as it requires accidentally favourable circumstances for its production, it is of no practical importance.

The *vaginal walls* at this period are distinctly softened; blue discoloration and softening of the cervix are more distinctly recognisable than at earlier periods. Since abdominal examination yields positive signs of pregnancy, from this period onwards vaginal examination is unimportant for purposes of diagnosis.

Thirty-sixth week.—The shape of the abdomen and the size of the uterus are indicated in fig. 38. The individual parts of the body of the fœtus can now be recognised by abdominal palpation, and the position of the head, back, and limbs localised. This, however, is of little importance in the diagnosis of pregnancy, but attention will be again directed to it in the section dealing with labour (see p. 222). About the thirty-eighth week the uterus attains its greatest height in the abdomen, extending nearly to the xiphoid cartilage, and the maximum abdominal girth averages thirty-two inches; during the last fortnight of pregnancy it may sink to a point midway between the umbilicus and the xiphoid cartilage, and the shape of the abdomen is in consequence a little altered (fig. 38). Numerous striæ are found below the umbilicus, which is now flat or slightly everted.

Differential Diagnosis of Pregnancy.—To consider all the varieties of abdominal swellings which may be mistaken for a pregnant uterus would require a wide excursion into the domain of gynæcology, and cannot be undertaken here. It is, however, necessary to recall the occasional occurrence of a curious imitation of pregnancy of hysterical origin which is known as *Pseudocyesis* (spurious pregnancy). It occurs in women of neurotic temperament, especially when associated with either dread of pregnancy, as in the unmarried, or desire to become pregnant, as in sterile married women. Such women present the symptoms of amenorrhœa, morning sickness, and progressive abdominal enlargement; they quicken, and feel what they regard as continual and active fœtal movements; and at the appointed time they suffer from severe and prolonged abdominal pains which they are convinced represent labour, but which of course have no result. On physical examination certain signs of mammary activity may be found, which are undoubtedly deceptive. The abdominal enlargement, however, will seldom deceive any but the most inexperienced practitioner; none of the positive signs of pregnancy can be detected either by abdominal or vaginal examination: and if an anæsthetic is administered the abdomen becomes flattened (unless the patient is very obese), and bi-manual examination will demonstrate that the uterus is not enlarged.

Multiple Pregnancy

While it is the rule in the human species for only one child to be born at a birth, twin pregnancy occurs in the proportion of about 1-80 to 1-90 births; but its frequency varies greatly in different countries, and heredity appears to be an important factor in its causation. Triplets are very much less frequent than twins, and are estimated to occur only once in 6,000 to 10,000 pregnancies. Quadruplets are still less common; although they may reach the period of viability and be born alive, they seldom all survive. Quintuple pregnancy is extremely rare, and always ends in abortion.

Twin Pregnancy may result from the simultaneous fertilisation of two ova, or from the fertilisation of a single ovum; the former are called *binovular*, the latter *uniovular* twins. *Binovular* twins may result from the fertilisation of an ovum from two distinct Graafian follicles, or of two ova from a single follicle. Sometimes two follicles ripen simultaneously in one ovary. The ova may both develop in the normal uterus, or one in each half of a double uterus; or one in the uterus, the other in the Fallopian tube; or one in each tube. They are much more frequent than uniovular twins, the proportion being about 6 to 1. We can only speculate upon the manner in which *uniovular* twins are produced. The ovum may possess two germinal vesicles (nuclei); or two embryonic areas may be formed if an ovum is fertilised by more than one spermatozoon; or the single embryonic area may divide, each half producing a fœtus. Differences between binovular and uniovular twins are to be found in sex, in development, and in the formation of the placenta and membranes. In each variety hydramnios of one ovum may occur, the other remaining normal.

Sex.—Uniovular twins are always of the same sex; binovular twins may be of the same or of different sex, the latter being rather more common than the former. Therefore twins of the same sex may be developed either from one or two ova, while those of different sex are necessarily binovular. Including all cases, twins are more commonly of the same sex (boy and boy, or girl and girl) than of different sex, and as in single pregnancy the number of boys exceeds that of girls. *Development.*—A twin fœtus is usually somewhat smaller and lighter than a single fœtus; the two are frequently unequal in size, and differences of 1 lb. to 1½ lb. in weight are not uncommon. One may be normally developed, the other malformed; or one may perish during pregnancy while the other develops till term. Malformations are common with uniovular twins, and certain forms of monstrosity only occur in such fœtuses (see p. 330). *Placenta and Membranes.*—With *binovular* twins the two ova may develop quite separately from one another, so that two separate placentæ and two complete sets of membranes are formed (fig. 39). If, however, the two ova should be implanted close to one another in the uterus, the two placentæ will be in contact, and they may even become more or less firmly united by their adjacent edges; the decidua capsularis then forms a single envelope for the two ova, so that the two chorions are apposed where the ova come

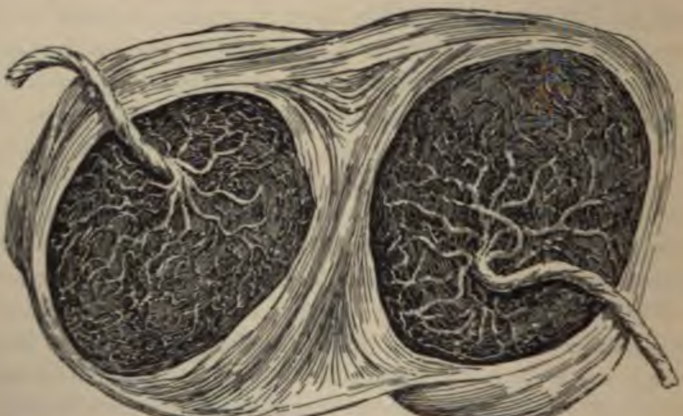

FIG. 39.—TWIN PLACENTÆ AND MEMBRANES OF BINOVULAR DEVELOPMENT. (RIBEMONT-DESSAIGNES AND LEPAGE.)

in contact. The circulatory system of each fœtus is quite distinct, even when the placentæ are united; anastomoses never occur. With *uniovular* twins a single placenta and chorion are formed; the amnion may be double (fig. 41) or single (fig. 40), the septum in the former being frequently incomplete at term. Usually the umbilical cords are distinct; sometimes the cord is single at its placental insertion, but bifurcates before reaching the fœtuses. Free anastomoses always exist in the placenta between the circulatory systems of the two fœtuses, and according to Schatz this is usually arterial, but may rarely be venous; venous anastomoses (placental) are superficial, arterial anastomoses are deep. As a result of these anastomoses blood from one fœtus finds its way into the circulation of the other—an important factor in the production of certain fœtal monstrosities. One fœtus may also have at its disposal a larger placental area than the other, the one thus favoured being always the more fully grown. Such monstrosities as the thoracopagus and omphalopagus are only possible in twins of uniovular development.

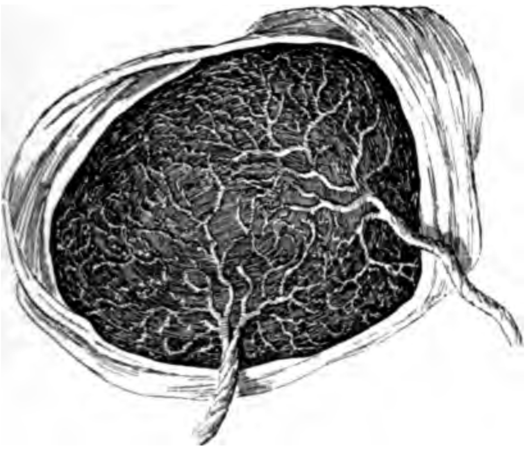

FIG. 40.—TWIN PLACENTÆ AND MEMBRANES OF UNIOVULAR DEVELOPMENT. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Superfecundation and Superfœtation.—If two ova are fertilised simultaneously, twin pregnancy results; sometimes a second ovum is fertilised while the first is developing, and to this condition the above terms are applied. If the interval between the two separate acts of fertilisation is a short one, the condition is called *superfecundation*: instances are well known to occur in lower animals, as when, for example, a mare gives birth to a horse and a mule at a single labour, having been covered at about the same time by a stallion and an ass. Proof of its occurrence is difficult in the human subject, and unless

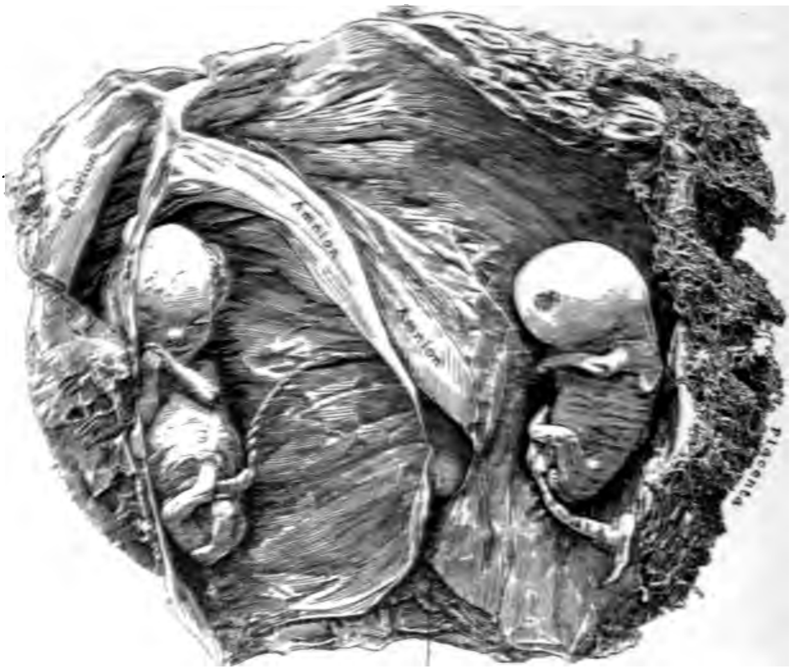

FIG. 41.—TWIN PREGNANCY (PROBABLY UNIOVULAR); ABORTION AT THIRD TO FOURTH MONTH. (CHARING CROSS HOSPITAL MUSEUM.)
Note that torsion has occurred in the umbilical cords.

the fœtuses are of different colour it is indistinguishable from binovular twin pregnancy. When the interval between the two acts of fertilisation is considerable, amounting to weeks or even months, the condition is called *superfœtation.* If it is true that ovulation continues during early pregnancy, there is no obstacle to the fertilisation of a second ovum and its lodgment in the uterine cavity, so long as the decidual space persists *i.e.* up to the end of the fourth month. The result of this would be the presence in the uterus of two fœtuses of different stages of development. It is easy to conceive of such an occurrence at any period of pregnancy in a double uterus, or in the Fallopian tube. Superfœtation may end in abortion, both ova being thrown off before they are viable; or one ovum developing to full time, a mature fœtus and a premature one may be born at the same labour; or the birth of a mature fœtus may be followed after an interval of a few weeks by the birth of a second equally mature.

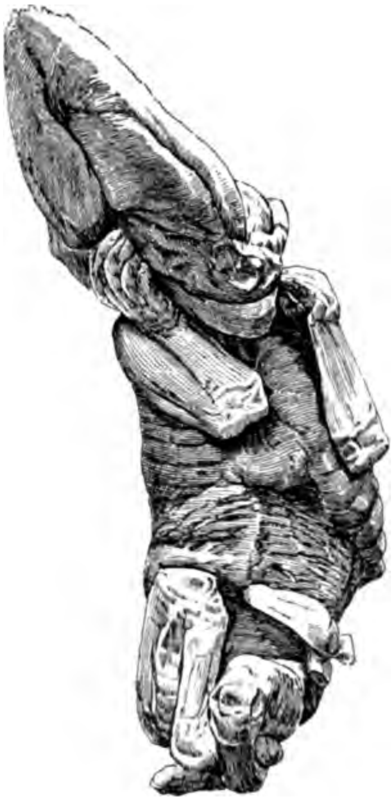
FIG. 42.—MUMMIFIED FŒTUS (FŒTUS PAPYRACEUS).
(CHARING CROSS HOSPITAL MUSEUM.)

Clinical Course of Twin Pregnancy.—Diagnosis is impossible during the early months; it can only be established by the detection in the uterus of two fœtuses. The uterus is always larger than normal, but undue enlargement must not be attributed to twins without more definite evidence. The surest sign is the recognition of two distinct fœtal hearts, beating at different rates. This sign cannot be detected until after the sixth month, and unusual care must be exercised in establishing the difference in rate between the two hearts. It is not sufficient for the observer to find fœtal heart-sounds audible at two different parts of the uterus, for rapid changes in the position of the fœtus may occur, and thus lead to mistakes. Two observers auscultating at the same moment should simultaneously count the fœtal heart-sounds to which they are listening, and if a definite difference of, say, ten beats per minute is detected between them, twins may safely be diagnosed. This difference in rate depends in the main upon inequality in size of the fœtuses; but if there is no inequality there will be no recognisable difference in rate. Towards the end of pregnancy the presence of a fœtal head may sometimes be recognised both at the fundus and in the lower uterine segment. When twin pregnancy is complicated with hydramnios, there is great difficulty in diagnosis.

Twin pregnancy usually ends a little before term: that is to say, labour is premature. Owing to the undue size of the uterus, pressure-symptoms may be unusually troublesome, and morning sickness is said to be unusually severe. Sometimes the uterus is not much larger than normal; this may be due to the fact that one fœtus has perished *in utero*. When this occurs the fluid in the dead ovum is absorbed, and the body of the fœtus compressed between the growing ovum and the uterine wall, and its tissues altered by absorption of

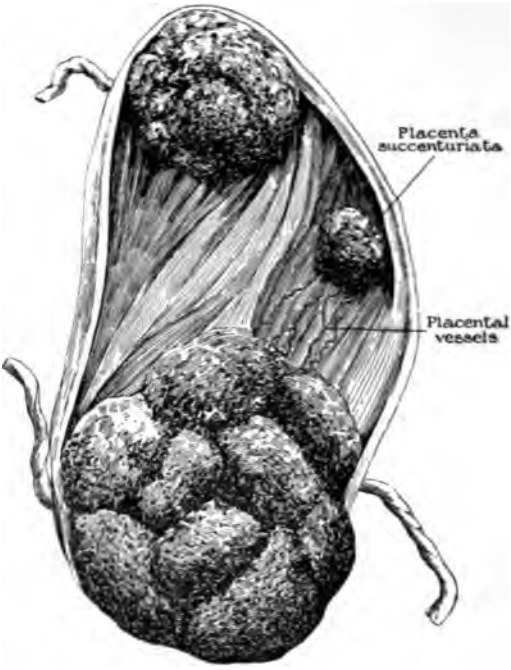

FIG. 43.—TRIPLET PLACENTA DEVELOPED FROM TWO OVA, AND SHOWING THE ABNORMALITY OF PLACENTA SUCCENTURIATA. (RIBEMONT-DESSAIGNES AND LEPAGE.)

fluid; the result is the birth of a curiously flattened mummified fœtus, to which the term *fœtus papyraceus* or *fœtus compressus* has been applied (fig. 42). The placenta of this fœtus offers a striking contrast with that of the living one; it is pale, and completely consolidated on section, no trace of the normal spongy tissue remaining. Microscopically it presents the appearances characteristic of advanced infarction and fatty degeneration.

Triplets result from the fertilisation of three separate ova, or from the occurrence of uniovular twins with an ordinary single fœtus. In the former case three distinct placentæ and sets of membranes are found; in the latter and commoner case there are two placentæ of very unequal size, the larger having two cords attached, and corresponding to the placenta of uniovular twins (fig. 43). The single fœtus may have a distinct set of membranes. Triplets are more commonly of different sex than all of the same sex, but boys predominate considerably in number. Diagnosis is very difficult, and labour always comes on prematurely. The survival of all three infants is rare.

The Management of Normal Pregnancy

Although pregnancy is a normal bodily function, and should not be regarded as a malady, it is undoubtedly attended by many risks, and it involves a considerable strain upon certain organs, which they may be unable to bear unless care is taken to maintain them in a condition of normal physiological activity. This is especially the case in a first pregnancy; afterwards the organism appears to be able to bear with less disturbance the altered conditions involved in the pregnant state. The functions which require the closest attention are those of digestion and excretion, for their failure may involve the most serious consequences both to the mother and the child. Consequently the bowels, the skin, and the kidneys should be kept freely active. Diet is of some importance, inasmuch as all hepatic disturbances of dietetic origin should be guarded against on account of the serious results liable to follow a breakdown of the hepatic functions (see p. 76). The appetite is generally increased during pregnancy, and patients do not as a rule require encouragement to take the amount of food which is necessary and desirable. Over-feeding is distinctly undesirable under normal conditions. Exercise is necessary, but should not be violent or attended by much risk of accident, which may result in abortion. The more energetic forms of outdoor exercise should be avoided, but walking is useful at all periods. If for any reason exercise cannot be taken, daily massage of the limbs and back form a useful substitute for it.

Few, if any, of the ordinary symptoms of pregnancy require treatment. If morning sickness is troublesome the patient should take her first meal before rising, preceded by a mild aperient, such as a seidlitz powder or a dose of Apenta water. If nausea continues during the day, alkaline remedies, such as the salts of bismuth, soda, and magnesia, are useful. During the later months pressure-symptoms are often much relieved by wearing a well-fitting abdominal belt. The urine should always be examined at least once in the first three months, and a regular monthly analysis should be made during the second half of pregnancy, on account of the liability to the appearance of albuminuria at this time. This is of especial importance in a primigravida. Success in treating this serious complication depends entirely upon its early recognition (see p. 86).

Examination of the gravid uterus during the early months of pregnancy is unnecessary, and should be avoided unless required for purposes of diagnosis. A physical examination should, however, always be made at about the thirtieth week to determine (1) the presentation and position of the child; (2) the relation between the size of the head and that of the pelvic brim; (3) the condition of the bony and soft maternal passages; (4) the presence and rate of the fœtal heart-sounds. The importance of determining these points well in advance of term will be made clear in the section dealing with the management of labour. The examination of presentation and position should be repeated two or three weeks before labour begins.

During the last six or eight weeks of pregnancy the nipples must be prepared for suckling in the manner described [illegible] 404.

PART II

ABNORMAL PREGNANCY

Although pregnancy is not a disease, but a normal function of the body, there is no doubt that a pregnant woman is exposed to many serious risks which are peculiar to her condition, while certain maladies to which all women are liable are of increased gravity when associated with the pregnant state. In addition, there are risks of minor importance primarily affecting the ovum, for pregnancy may be interrupted prematurely and the ovum thrown off from disease or accident before the fœtus is viable. The pathology of pregnancy thus assumes very large proportions, and comes to embrace a great number of morbid conditions which may affect the mother, the embryo, or the fœtus and its appendages. In order to make the subject intelligible, and capable of being dealt with briefly, classification is required, but a practical classification is by no means easy to devise. A simple division into the main groups is, however, easily made; for while some of the conditions included are abnormal developments of pregnancy—*i.e.* conditions necessarily associated with the pregnant state—in the case of others the association with pregnancy is only accidental. The first group we may call THE DISORDERS OF PREGNANCY, for pregnancy is the essential factor in their causation. As examples may be mentioned the disease called *eclampsia*, and the *hydatidiform mole* (vesicular degeneration of the chorion); none but pregnant women suffer from these diseases and their many consequences, and they are directly due to some disturbance of the normal course of pregnancy. The second group we may call THE DISORDERS ASSOCIATED WITH PREGNANCY; they may have been in existence before conception occurred and have become aggravated by pregnancy, such as *valvular disease of the heart*; or they may arise during the course of pregnancy and interrupt it, like the *acute eruptive fevers.* Instead of subdividing the first group into *fœtal* and *maternal* disorders, as is usually done, we shall classify them as follows :

I. Disorders of Pregnancy.

A. *General Disorders—Auto-intoxication* (Toxæmia).
  (1) Albuminuria and Eclampsia.
  (2) Pernicious vomiting.
B. *Reflex Disorders.*
  (1) Ptyalism.
  (2) Pruritus.
  (3) Mental disturbances.
C. *Abnormal Conditions of the Gravid Uterus.*
  (1) Displacements.
  (2) Malformations.
D. *Pressure-symptoms.*
  (1) Œdema.
  (2) Varicose veins.
  (3) Hæmorrhoids.
E. *Abnormal Conditions of the Ovum.*
  (1) *The Early Ovum.*
    (*a*) Moles.
      i. Blood mole—Fleshy mole (hæmatoma mole).
      ii. Hydatidiform mole (vesicular degeneration of chorion).
    (*b*) Decidual endometritis.
  (2) *Placenta and Membranes.*
    (*a*) Oligo-hydramnios.
    (*b*) Poly-hydramnios.
    (*c*) Placental diseases.
      Œdema.
      Fatty degeneration.
      Hæmorrhage.
      New-growths.
      Syphilis (doubtful).
      Tubercle.
      Infarction.
F. *Abnormal Implantation of the Ovum.*
      Ectopic gestation.

II. Disorders associated with Pregnancy.

- (*a*) Acute eruptive fevers.
- (*b*) Syphilis and tubercle.
- (*c*) Cardiac disease.
- (*d*) Renal disease.
  - Bright's disease; pyelitis.
- (*e*) Hepatic disease.
  - Acute yellow atrophy; diabetes.
- (*f*) Diseases of nervous system.
  - Chorea.
- (*g*) Pelvic diseases.
  - Ovarian and uterine tumours.
  - Gonorrhœa.

This list, though not exhaustive, will be found to comprise the conditions which are of practical importance.

General Considerations.—It will readily be understood that the conditions comprised in the first group are much more important than those of the second, which will not call for detailed consideration. Of the Disorders of Pregnancy the first division, termed General Disorders, includes conditions the causation of which has always been obscure, and although we are now approaching an explanation which promises to be much more satisfactory than any that have been previously advanced, unanimity of opinion has by no means been reached in regard to them. This explanation is that these disorders result from auto-intoxication or *toxæmia*, produced in part by deficient elimination through the kidneys, intestines, and skin, and in part by increased production of toxic materials in the maternal organism from perverted or inefficient action of the liver and alimentary system, or by the passage of fœtal waste products into the maternal blood through the placenta. Reference has already been made to the fact that attempts to obtain experimental proof of a condition of toxæmia in normal pregnancy have hitherto been unsuccessful. The same methods have, however, been applied with greater success to certain disorders of pregnancy—viz. eclampsia and pernicious vomiting. The experimental results, considered carefully in connection with pathological anatomy, certainly establish a *prima facie* case that eclampsia is the result of toxæmia or auto-intoxication. The great advantage which this theory possesses over the older ones is that it rests upon a pathological foundation and is applicable to almost all cases, and thus tends to introduce order into what was previously a most confusing chapter of obstetric pathology.

The toxæmic theory may be stated briefly as follows. In health the waste products of the body-tissues are disposed of either by direct excretion through the kidneys, skin, and intestines, or by transformation into harmless substances within the body; the organ mainly concerned in the latter process is the liver, with perhaps, secondarily, certain ductless glands such as the spleen, the thyroid, and the suprarenal bodies. In normal pregnancy, although an excess of waste products may enter the maternal blood from the uterus and ovum, the normal channels of excretion and transformation suffice for their removal. In addition, indications are not wanting that certain alterations in the general metabolism of the body also occur during pregnancy; although their significance is not at present clear, they must be regarded as important in respect to the delicate balance of the functions of ingestion and elimination. At present it can only be said that in all probability the beginning of toxæmia is to be found in altered metabolism, and that from this may result alterations, either functional or anatomical, in such important eliminatory organs as the liver and the kidneys. In order to maintain in pregnancy the normal equilibrium, it is clearly necessary that all the maternal organs concerned should retain their functional activity, and even perhaps increase it above the normal level. A physiological breakdown on the part of important organs ike the liver or kidneys must necessarily entail serious consequences—much more serious than in the non-gravid state, and further accumulation of waste products in the blood will become inevitable. The organs which most commonly show clinical signs of failure during pregnancy are the kidneys, and this failure, as we shall see, is probably accompanied by certain pathological changes in the renal cortex. The increased amount of waste products passing through the kidneys may directly excite these changes; and possibly the real fault lies with the liver, which may fail adequately to convert waste oducts of an irritant nature into the comparatively harmless id constituents of normal urine.

Anatomical evidence of serious hepatic disease is usually to be found in fatal cases of eclampsia and pernicious vomiting. In less severe cases evidence of the liver being actually diseased has not been obtained, and it is possible, therefore, that structural hepatic disease is a late result of the toxæmic process, which may begin as a functional breakdown only. Inadequate renal excretion will aggravate the toxic state, and may thus directly contribute to the causation of structural changes in the liver and kidneys incompatible with life.

Of late years further indications of the existence of toxæmia have been sought for in a study of the total nitrogen excretion in the urine. Under conditions of health about 87 per cent. of the total urinary N is excreted as urea, 3 per cent. as ammonia salts, and the remainder as creatinin, uric acid, &c. (Folin). Cases of pernicious vomiting have been observed in which it was found that the proportion of N excreted as NH_3 rose to 10 per cent., and the view was advanced that this rise constituted an important diagnostic indication of the disease (Williams). Further observation, however, has shown that a similar rise in the proportion of N excreted as NH_3 occurs from the substitution of a proteid-free diet for the ordinary mixed diet, and also from starvation. Williams's conclusions therefore require revision, for cases of pernicious vomiting are usually treated on dietetic lines calculated in themselves to produce a high ammonia output.

While the toxæmic theory has been worked out mainly in relation to eclampsia and pernicious vomiting, it is possible that toxæmia may in time be shown to be an important factor, if not the only one, in the causation of other disorders.

Albuminuria and Eclampsia

Albuminuria occurring during pregnancy may be due to (1) *pre-existing renal disease—e.g.* chronic nephritis; (2) *pregnancy.* The latter is spoken of as 'the albuminuria of pregnancy,' and must be sharply distinguished from the former variety, which will be considered in the group of 'Disorders associated with Pregnancy.' Albuminuria and eclampsia must be considered together because, although eclampsia may very exceptionally occur without albuminuria, they are almost invariably associated. This association is indeed so marked that the conclusion cannot be avoided that they are due to one and the same cause. It must, however, always be borne in mind that the majority of cases of albuminuria terminate favourably without the supervention of eclampsia; but it may be said that the higher the degree of albuminuria the greater is the risk of eclampsia.

Strictly speaking, albuminuria is but a symptom, and in the disease which is conveniently designated 'the albuminuria of pregnancy' other clinical features of great importance are found besides the presence of albumen in the urine. We must be careful, therefore, to exclude, in addition to pre-existing renal disease, such transient causes of albuminuria as fatigue and dyspepsia, which may give rise to it temporarily in any circumstances. Albumen due to these causes only occurs in traces. Contradictory statistics have been published as to the frequency with which albuminuria is to be found in pregnant women, the proportion varying, according to different observers, from 3 to 50 per cent. The highest rate of frequency occurs in parturient women, and there is no doubt that in a large majority of primiparæ, and in a smaller proportion of multiparæ, traces of albumen occur in the urine during normal labour, and disappear at once when labour is over. This condition does not concern us at present, but will be referred to again later on. Excluding parturition, the rate of frequency of albuminuria in pregnant women probably does not exceed 3 to 5 per cent., and from this must still be deducted cases of pre-existing renal disease and cases of transient functional albuminuria. It will therefore be seen that the disease we are considering is fairly uncommon.

Clinical Features.—The albuminuria of pregnancy is practically confined to the latter half of the period of gestation, and seldom manifests itself earlier than the sixth month (twenty-sixth week), although cases of eclampsia at the fifth month have been recorded. It is much more frequent in primigravidæ than in multiparæ. Cases differ greatly in severity: in some the only symptom is a moderate amount of albumen in the urine, which disappears under treatment; or, even when persisting, it may be unaccompanied by other symptoms, and may not interrupt the development of the ovum or the course of pregnancy. Every case, however, requires careful management, for the risk of other and more serious symptoms supervening is always present. Thus albuminuria is frequently accompanied by other urinary changes, and by anæmia and anasarca; frequently it leads to death of the fœtus *in utero* and the occurrence of premature labour; more rarely it leads to the occurrence of retinitis and terminates in convulsions (*eclampsia*). These conditions must now be considered in more detail.

Urinary Changes.—In the earlier stages of the affection the urine is abundant, pale, of low specific gravity, and contains a diminished proportion of total solids. The amount of albumen present is a rough indication of the severity of the case. There may be but a trace; usually, however, the amount is considerable ($\frac{1}{6}$ to $\frac{1}{10}$ per cent. Esbach), and in the worst cases of all—viz. those which terminate in eclampsia—the urine usually solidifies on boiling when tested during the eclamptic seizures. It has been observed that a large proportion of the albumen is serum globulin, but we do not know the significance of this point, and, owing to technical difficulties in estimation, the exact proportion of globulin to albumen has not been worked out in a series of cases. Of more importance is the occurrence of casts which can usually be found; they are hyaline and granular, and often show fatty degeneration. Red and white blood-corpuscles are also occasionally found. The total amount of urea excreted is fairly normal, but a diminution usually occurs in connection with eclampsia, and a fall in the output of urea is an important premonitory sign of this complication. When anasarca is marked, the amount of urine excreted becomes scanty, while in eclampsia the secretion is very scanty, and may even be suppressed.

Anæmia and Anasarca.—These two conditions are usually associated, and it is rare to find one marked without the other being almost equally so. The pallor of the face and mucous membranes forms one of the most striking features of these cases, and gives rise at once to the suspicion of albuminuria. Severe frontal headache often occurs and sometimes vomiting. The anasarca affects chiefly the lower extremities, the vulva, and the abdominal wall; it is said to occur also in the face and upper extremities, but with such a distribution the greatest care should be taken to exclude chronic Bright's disease. The pre-eclamptic state is, however, sometimes attended with puffiness of the eyelids. The œdema of the lower extremities may be extreme, and sometimes the labia majora become greatly enlarged, so as to interfere with the dilatation of the vulva during labour. It is said that anasarca may occur to a marked degree without albuminuria, or that it may appear first, but this is unusual.

Death of the Fœtus, and Premature Labour.—A heavy fœtal mortality, probably over 50 per cent., attends the albuminuria of pregnancy. It is largely independent of eclampsia. The fœtus perishes *in utero*, and the ovum is then thrown off, either at once or within a few weeks; amelioration of the general symptoms sometimes follows the death of the fœtus even when it is retained for some time in the uterus. Often, however, a living premature child is born, but it is usually undersized and feeble, and its chance of surviving is but small. Placental disease is present in a considerable proportion of these cases, and appears to be an important factor in causing the death of the fœtus and in inducing labour prematurely. This disease consists in extensive infarction of the placental substance—a change which will be again referred to later on (see p. 117).

Eclampsia.—We do not know the exact proportion of cases of albuminuria which terminate in eclampsia; it is probably small. But eclampsia is by no means confined to cases in which there has been previous clinical evidence, of longer or shorter duration, of the existence of albuminuria. Eclampsia accompanied by albuminuria may suddenly supervene in pregnant women who have previously been in apparently good health; or eclampsia may sometimes come on in this way with no attendant albuminuria. The convulsions are indistinguishable in their general characters and course from those of uræmia, and the differential diagnosis from the former may present insuperable difficulties. Sometimes eclampsia is ushered in by a definite pre-eclamptic stage, the clinical recognition of which is of great importance (see p. 381). Eclampsia is most commonly met with as a complication of labour, and the consideration of its clinical features and treatment will therefore be postponed till a later section.

Pathological Anatomy of Eclampsia.—Cases of albuminuria are rarely fatal unless complicated with eclampsia; the pathology of the albuminuria of pregnancy has therefore been somewhat difficult to elucidate, but abundant evidence has now been accumulated to show that in fatal cases of eclampsia definite morbid changes occur in the kidneys, and a further series of changes is also found in the liver, spleen, and brain.

Kidneys and Ureters.—The most important changes occur in the renal cortex, and they are of the nature of degeneration, not inflammation. The whole kidney is enlarged, the cortex swollen and pale; the pallor (anæmia) appears to be due to vaso-motor spasm affecting the cortical arterioles. Cloudy swelling with granular and fatty degeneration of the epithelial cells of the renal tubules is apparent on microscopical examination (fig. 44). Small interstitial hæmorrhages and areas of necrosis are also found in the cortex. In albuminuria without eclampsia the degenerative changes occur, but not the areas of hæmorrhage and necrosis; this condition is often called the *pregnancy kidney*. These changes are transient,

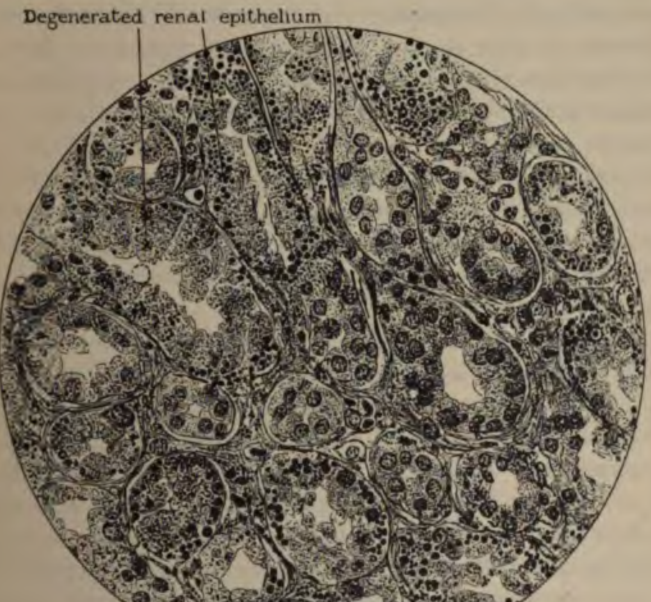

FIG. 44.—RENAL TUBULES FROM A CASE OF ECLAMPSIA; NUMEROUS FAT GLOBULES OCCUR IN THE DEGENERATED CELLS. (HAMILTON BELL.)

and are believed in the great majority of cases to disappear rapidly after labour, but it is stated that the condition may occasionally pass into true parenchymatous nephritis. The rapid disappearance of the renal changes can of course be watched by observation of the urine during the puerperium.

In a certain proportion of fatal cases of eclampsia, dilatation of one or both ureters above the level at which they cross the pelvic brim has been shown to occur, and some writers have estimated its frequency as one in five. The unfavourable influence of this change upon the functional activity, and even the structure, of the kidney is obvious. It is therefore a factor of importance in the causation of albuminuria, but it must be regarded as a contributory, not an essential, factor. It is most frequently found in primigravidæ, and may be occasioned by the uterus itself, or by direct pressure of the fœtal head upon the ureter; for we know that in the last two to three months of pregnancy the fœtal head occupies the pelvic brim in primiparæ.

Liver.—Changes in the liver are practically invariably present in fatal cases of eclampsia. Sometimes these changes are only to be found on microscopic examination; sometimes the organ is enlarged and shows multiple, small, subcapsular hæmorrhages; sometimes it is small and bright yellow in colour, like the liver of acute yellow atrophy. Microscopically areas of liver-cells are found to be undergoing marked granular and fatty degeneration, other areas are markedly necrotic, interstitial hæmorrhages are numerous, and there are numerous minute infarctions due to embolism or thrombosis of branches of the portal vein. The changes, in fact, resemble in a striking manner either those found in acute yellow atrophy, or in conditions of acute septic intoxication.

Spleen.—Changes in this organ somewhat similar to those found in the liver may be met with in cases of eclampsia.

Brain.—Cerebral hæmorrhages rarely occur in eclampsia, but anæmia and œdema of the brain-substance are of frequent occurrence.

Fœtus.—It is a significant fact that convulsions may occur in the child born of an eclamptic mother; usually, however, it is born dead. In the fœtal liver, changes resembling those described in the maternal liver, have been met with, and some observers state that they can always be found. Renal changes also occur, but it is difficult to distinguish them from similar changes not uncommonly found in fœtuses which die from other causes during delivery.

Etiology.—It is practically certain that the immediate cause of the *albuminuria of pregnancy* is to be found in the degenerative changes in the renal cortex. Anæmia of the cortex from arterial spasm, directly set up by the toxic condition of the blood circulating through the kidneys, is probably the first change. The degenerative changes which follow lead to albuminuria and the formation of casts, and thus the morbid condition of the maternal blood becomes aggravated by the deficient functional activity induced in the kidneys. Dilatation of the ureters, when present, may be a contributory factor in their causation, but the state of the blood is probably the essential factor in all cases. General anæmia and anasarca may also be explained by the toxic condition of the blood; and the same explanation will obviously account for the death of the fœtus *in utero*, through direct intoxication or through the changes induced in the placenta. The precise nature and origin of the morbid condition of the blood must be regarded for the present as unsettled. The nature of the toxic bodies is unknown, but they are in all probability of maternal, not fœtal, origin; until they have been isolated further information will be difficult to obtain.

The causation of *eclampsia* is more complex than that of albuminuria. It is probable that the morbid condition of the blood steadily increases, gradually inducing changes in the liver and spleen, and when the toxæmia reaches a certain height convulsions suddenly supervene. The cerebral changes found after death are probably due in the main to the convulsions themselves. The toxæmic theory of eclampsia forms the best explanation we possess of the great majority of cases of this disease; but there are difficulties in the way of accepting it as the explanation of all cases.

Instances occasionally occur in which eclampsia is not preceded by albuminuria, and in which no recognisable changes can be found in the kidneys on post-mortem examination. Marked changes are, however, found in the liver, and it has been suggested that these cases are examples of toxæmia of a purely hepatic type. If this suggestion is adopted, then two types of eclampsia may be recognised—the common *renal* type in which the kidneys play the most important part, and the rare *hepatic* or *gastro-hepatic* type in which the liver is chiefly concerned, and not the kidneys. It must be admitted that this view has not yet received sufficient support to warrant its general adoption. But should further observation confirm it, then possibly it may be found that the hepatic type will also comprise those cases in which eclampsia, accompanied by marked albuminuria, suddenly comes on without *previous* evidence of renal disturbance.

One of the most serious obstacles to the general adoption of the toxæmic theory is that in a considerable proportion of cases eclampsia begins after labour, during the first few days—first to fourth—of the puerperium (see p. 381). Dührssen found that out of 195 cases 24 per cent. began in the puerperium: the lowest estimate based upon a sufficient series of cases is 14 per cent. Now clinical observations have shown that rapid improvement in the condition of the kidneys usually follows delivery in cases of albuminuria, and it is believed that the toxic condition of the blood speedily disappears. In the cases under consideration we must assume the continuance or the exacerbation of the toxæmia after labour. This presents great difficulties, since it is the opposite of what usually occurs: but it may be said that these cases are almost equally difficult to explain upon any other theory of eclampsia that has ever been advanced. Clinically they are seldom severe, and rarely fatal, and we know little of their special post-mortem characters.

Mention must now be made of other theories which have been advanced in explanation of eclampsia. The older theories were mainly *mechanical*. Increased intra-abdominal pressure was regarded as the main factor, and was thought to act upon the ureters, for which there is post-mortem evidence, or upon the renal veins, for which there is none. The comparative frequency of its occurrence in primigravidæ and in association with over-enlargement of the uterus was regarded as an important support of the mechanical theory. As we have seen, pressure upon the ureters may well be regarded as a contributory cause of the renal changes. Increased arterial tension and hydræmia have been also advanced as causes of eclampsia, acting directly on the brain: but as these blood-conditions are constantly present in pregnant women, the frequency of eclampsia ought to be very great if this explanation is correct.

One of the older theories, which appears to have been first advanced by Virchow, was that eclampsia was occasioned by the excess of waste products circulating in the maternal blood, derived in the main from the fœtal products of metabolism. Clearly this is but an anticipation of the modern theory of toxæmia, the chief difference being that in the old theory the toxic products were fœtal, in the modern theory they are maternal.

A bacterial cause has of course been suggested, but no satisfactory isolation of an organism has ever been made. In this connection, however, it must be noted that there is a certain amount of evidence that eclampsia may assume an epidemic form; at any rate its occurrence in a series of cases, followed by long intervals of freedom from it, has been observed in several maternity hospitals.

Insufficient activity of the thyroid gland, leading to deficiency of *iodothyrin* in the tissues, has recently been advanced by Nicholson as the cause of, at any rate, some cases of eclampsia. This substance he regards as important in controlling the functions of hepatic and renal elimination. The suggestion would best be classed as a variant of the toxæmic theory; but it rests mainly upon speculative reasoning, reinforced by certain clinical observations on the results of administering thyroid extract in eclampsia and the pre-eclamptic stage.

Conclusions.—The *albuminuria of pregnancy* is due to degenerative changes in the renal cortex, probably induced by a toxic state of the blood. *Eclampsia* is in the majority of cases due to the same cause, the toxic condition of the blood being extreme; the lesions observed in the kidneys, liver, and spleen are the results of this toxæmia. Primigravidæ are especially liable to it, owing in the main to the severity of the general physiological disturbance in a first pregnancy. The nature of the toxic substances is unknown; their source is maternal, not fœtal. A contributing factor in the causation of eclampsia may be found in dilatation of the ureters from direct or indirect pressure. There is no reliable evidence of eclampsia being caused by micro-organisms, or by insufficiency of thyroid secretion.

Treatment of the Albuminuria of Pregnancy.—The early recognition of the occurrence of albuminuria in pregnancy is of great importance both to the mother and the fœtus. Regular examination of the urine every month during the last three months of pregnancy in the case of a primigravida, whether healthy or not, ought to be regarded as indispensable, in order to obtain the earliest indication of renal trouble. The importance of treating albuminuria lies in the fact that such treatment is almost always successful in averting eclampsia, and must be insisted upon in all cases, whether the patient is obviously ill or not. During the course of the treatment daily estimations of the total urinary secretion and of the output of urea ought also to be made, for a fall in the excretion of urea is an important premonitory sign of eclampsia.

The treatment consists in the main in promoting free action of the various organs of excretion and regulating diet so as to diminish as far as possible the work thrown upon the digestive organs, especially the liver. Milk should be the staple article of diet, and the patient should take from three to six pints daily, but except in the worst cases fish and chicken may be added. Alcohol, meat, and rich food must, of course, be forbidden. In a severe case the patient should be confined to bed. Saline purgatives or calomel are also useful; diuretics, such as barley water or Vichy water, in large quantities, or simple diuretic drugs, such as acetate of potash and spiritus ætheris nitrosi, are usually given. The skin should be kept acting freely by daily sponging, or, if necessary, hot-air baths or the wet pack. Daily injection of considerable amounts (Oj to Oij) of normal saline solution into the rectum has been found very useful, acting as a powerful diuretic. In a severe case it may be injected subcutaneously under the mamma in quantities of about half a pint, when it acts more rapidly. The effect of treatment can easily be watched by systematic examination of the urine, and in a favourable case the amount of albumen will diminish and the casts disappear, while the amount of urea remains satisfactory; but it will be remembered that upon milk diet the excretion of urea is naturally below normal. The anasarca will also diminish greatly if the patient is kept in bed. If the course of the disease cannot be controlled in this way the prognosis is grave; the fœtus will probably die *in utero*, or premature labour may come on, with the sacrifice of the life of the child, or possibly the dreaded complication of eclampsia may supervene.

The induction of premature labour in cases which resist medical treatment is perfectly justifiable and should not be delayed. It offers an escape from the risks of eclampsia, and, the chances of the fœtus being already seriously jeopardised, the question can be weighed almost solely with reference to the interests of the mother. The treatment of eclampsia will be considered in connection with the complications of labour (p. 383).

Hyperemesis Gravidarum: Pernicious Vomiting.

The common occurrence of nausea and vomiting as a symptom of normal pregnancy, present usually from the second to the fourth or fifth month, has been mentioned on a previous page (p. 55). As a symptom it varies greatly in severity, but does not affect the patient's health and has no unfavourable influence upon the ovum. The disease known as hyperemesis gravidarum is met with at the same period of gestation, and all gradations between ordinary morning sickness and the worst forms of this disease may be met with. Great divergence of opinion has been expressed upon its causation, and it has gradually become evident that a number of different conditions have been included and described under the same name. Three groups of cases, the causation of which is essentially different, may be distinguished.

First.—Such conditions as gastric ulcer, gastric cancer, alcoholic gastritis, cirrhosis of the liver, and cerebral disease —conditions which are all characterised by vomiting—when occurring in association with pregnancy, may give rise to intractable vomiting. These causes must therefore be excluded by careful clinical examination before the case can be considered as an example of vomiting due to pregnancy. Occasionally chronic intestinal obstruction has been overlooked on account of the obtrusive character of the vomiting, and the case treated as one of pernicious vomiting, with disastrous results.

Second.—Severe vomiting in pregnancy may be due to hysteria. As a rule, hysterical vomiting does not lead to loss of flesh, but wasting is often associated with severe forms of neurasthenia; and in pregnant women an alarming combination of the two symptoms of vomiting and loss of flesh is sometimes met with from hysteria. The urine, although diminished in quantity from vomiting or from diminished intake of fluid, remains otherwise healthy. This point is of great importance in diagnosis. Other manifestations of hysteria are often present in such cases, and even in their absence the true nature of the case may be demonstrated by its being curable by strong mental impressions, by hypnotic suggestion, or by isolation. It is well known that in women of neurotic temperament the tendency to hysterical manifestations is greatly aggravated by pregnancy. Numerous cases have been recorded in which hyperemesis gravidarum has been cured by the treatment of such local conditions as backward displacement of the gravid uterus, laceration and erosion of the cervix, &c. Now these local conditions cannot be accepted as the cause of hyperemesis, for they frequently occur in pregnant women without leading to this symptom, and hyperemesis frequently occurs when they are absent. To say that the vomiting is 'reflexly' excited by such pelvic lesions is an assumption for which no warrant exists. The cures recorded in such circumstances can only be attributed to 'suggestion'—*i.e.* the mental effect produced upon a neurotic patient by the treatment adopted.

Third.—In this group no cause whatever can be found for the vomiting except the existence of pregnancy. The worst cases of all are of this class, and it would be convenient to restrict the term 'pernicious vomiting' to them. Only recently has light been thrown upon their causation by the recognition, in fatal cases, of lesions in the liver and kidneys, closely resembling those found in fatal cases of eclampsia (see p. 77). Whitridge Williams states that while in eclampsia the necrotic and degenerative changes begin in the portal spaces and invade the hepatic lobule from the periphery, in pernicious vomiting they begin in the centre of the lobule. The changes in the kidneys appear to be the same as those found in eclampsia. It is therefore highly probable that these cases are due to toxæmia; but in its nature this toxæmia differs in some respects from that of eclampsia, for it manifests itself at a much earlier period of pregnancy, and gives rise to essentially different symptoms. Whether the toxic bodies have a different source we do not know, and until they have been isolated and their constitution determined, further information will be very difficult to obtain.

Associated with severe vomiting in pregnancy are sometimes found such conditions as uterine displacements, cervical laceration, fibroid tumours, hydramnios, hydatidiform degeneration of the chorion, and decidual endometritis. This association is probably merely accidental, and nothing but confusion results from regarding these conditions as causal factors.

Clinical Features. – Cases belonging to the first class cannot be considered here; the essential cause of the vomiting is the organic disease which is present, and the treatment must be appropriate to this condition.

In cases belonging to the second class (*neurotic type*) vomiting is at first the only symptom of disorder which is to be found; the tongue remains clean and the temperature normal, though the pulse may be accelerated. The severity of the vomiting varies greatly in different cases, and in the worst it occurs whenever food is introduced into the stomach. The result is wasting from starvation, and the patient may become much emaciated and enfeebled. Abortion not infrequently occurs spontaneously, and in the exhausted state of the patient it is attended by serious risks from hæmorrhage and sepsis. The vomiting usually ceases immediately upon the evacuation of the uterus.

In cases of true *pernicious* or *toxæmic* vomiting three stages or periods may be described: a stage of *vomiting and emaciation*, a stage of *fever*, and a stage of *coma* or *delirium*, the latter invariably leading to a fatal termination. These stages cannot always be definitely recognised: many cases terminate by abortion or recover under treatment before the third stage is reached. Cases in the first stage are difficult to distinguish from those of the hysterical type. Vomiting is the earliest symptom, consisting at first in the simple rejection of food by the stomach, either immediately or soon after it has been taken. Growing rapidly more severe, it may become almost incessant, bile-stained fluid being thrown up in large amount, and the patient rapidly becomes emaciated. Intense thirst and severe epigastric pain are complained of. The urine is scanty and contains albumen, numerous casts, and sometimes blood. The total urea output is diminished, while the ammonia coefficient is raised to about 10 per cent.; but it has been already pointed out that the latter change cannot be regarded as a direct indication of toxæmia (p. 77). Then fever appears, the temperature rising to 103° or 104° F., and accompanying it there is an exaggerated acceleration of the pulse-rate to 120 or 140—a symptom of graver significance than the rise of temperature. The tongue becomes dry and brown, the teeth collect sordes, diarrhœa sets in, and attacks of syncope may occur. If at this stage the fœtus should die, it is said that gradual amelioration of the symptoms will occur even if the patient should not immediately abort. Abortion is attended with serious risks, but if the patient survives them it invariably arrests the disease. Should the case go from bad to worse, delirium and coma occur; syncopal attacks become more severe; vomiting may cease, but if it continues the vomited matter contains blood, and a fatal termination is then almost inevitable. It will be noticed that in the later stages certain points of resemblance to eclampsia are met with in the condition of the urine, and the presence of coma; these points must be considered in relation to the post-mortem appearances, which, as has been said, closely resemble those of eclampsia. Sometimes the disease runs a fatal course in a month or six weeks, but in less severe cases its duration may be much longer. The mortality of *pernicious* vomiting is computed at 50 to 60 per cent.

Diagnosis.—It is of great practical importance to distinguish cases of the neurotic class from those of true pernicious vomiting. In both there may be severe or continuous vomiting, progressive loss of weight, rapidity of the pulse, and scanty urine. But any case in which albumen, blood, or casts appear in the urine, or in which considerable rise of temperature occurs (102° to 104° F.) should be regarded as toxæmic, and treated as such.

Treatment.—Before treatment is begun the greatest care should be exercised in excluding any organic disease to which the vomiting may be due, and in establishing the diagnosis of pregnancy. Time may be required to distinguish the *hysterical* type from the true pernicious vomiting; when the hysterical factor is obvious the patient should be isolated from her friends and placed in charge of an experienced nurse. Cases of moderate severity should be treated by confinement to bed, and restriction of food to peptonised milk; if even this is not retained, rectal alimentation should be practised for three to four days, during which nothing whatever should be introduced into the stomach. If the vomiting persists, or returns when stomach feeding is resumed, the following remedies are probably the most useful: hypodermic injections of morphia, one-minim doses of tincture of iodine every hour, bismuth with hydrocyanic acid, cocaine, and oxalate of cerium. Sinapisms applied to the epigastrium, and ice-bags to the spine, have been found useful. If the view be taken that the case is one of the *toxæmic type*, in addition to the above, rectal or subcutaneous injections of normal saline solution, repeated two or three times a day, are of service, but dietetic and medicinal treatment will only succeed in mild cases.

The obstetric treatment consists in the induction of abortion. The evacuation of the uterus always arrests the vomiting almost immediately; no better proof could be desired of the dependence of the disease upon pregnancy. There appears to be no reason why induction of abortion, if undertaken in time, should not be a safe and easy means of arresting the disease, but the statistics of induced abortion are extremely unfavourable. This is probably due in the main to the condition of the patient becoming desperate from delay before induction is resorted to. Lepage was able to report 66 per cent. of recoveries in a series of thirty-two recent cases in which induction was practised, but even this high mortality compares favourably with results published by previous observers. Induction should be advised before the febrile stage is reached; if vomiting persists in spite of medicinal and dietetic treatment, and is accompanied by a rapid pulse, marked emaciation, and the presence of albumen in the urine, the patient's life is in great danger, and there need be no hesitation at this stage in advising that pregnancy should be ended, without waiting for the appearance of symptoms of greater gravity.

The methods by which abortion may be induced will be considered in a later section.

Reflex Disorders of Pregnancy

Certain minor disorders often associated with pregnancy may be mentioned under this heading, although their dependence upon reflex irritation is a matter of assumption. *Ptyalism* is sometimes extremely troublesome in the early months of pregnancy, during the period at which morning sickness usually occurs. It may be associated with hyperemesis, and is by some writers regarded as a manifestation of toxæmia. *Pruritus* limited to the external genital organs is of frequent occurrence during pregnancy, and, although troublesome, is never of grave importance. Sometimes, however, general pruritus affecting the skin of the entire body occurs; it may be associated with eruptions of erythematous or eczematous type, or the skin may be unaffected in appearance. General pruritus may lead to serious consequences from sleeplessness and exhaustion due to ceaseless irritation. *Mental Disturbances.*—The liability of neurotic women to exacerbations of hysteria during pregnancy has been already referred to. Minor disturbances, such as sleeplessness, restlessness, and perversions of the appetite (longings), may also be met with; when insanity occurs it is usually in single women, and is attributed largely to mental distress and apprehension (see p. 443).

Backward Displacement of the Gravid Uterus (Retroversion, Retroflexion)

In the majority of cases this condition results from the occurrence of conception in a uterus which is already retroverted or retroflexed; more rarely a normally placed uterus becomes displaced during the first or second month of pregnancy by a fall, a violent muscular effort, or by overdistension of the bladder. Unless a history of such occurrences as these can be obtained, there is no means of distinguishing between the two modes of origin. The distinction between retroversion and retroflexion is not of practical utility, and no attempt need be made to consider them separately.

Backward displacement rarely gives rise to symptoms until the end of the third month has been passed (thirteenth week), and the symptoms which then appear are simply mechanical in their origin. At this period the gravid uterus is nearly globular in shape, having a diameter of from 3½ to 4 inches (fig. 31)—*i.e.* it is nearly as large as the pelvic cavity in the living subject. It therefore exerts pressure upon the pelvic contents, giving rise to pain and interference with the functions of the bladder and rectum. The prominent and characteristic symptom is retention of urine, either absolute

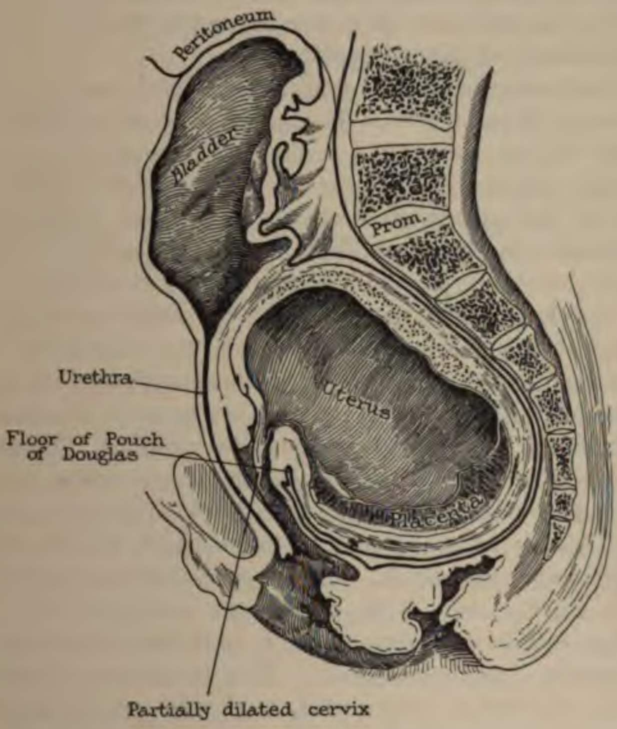

Fig. 45.—Retroflexed Gravid Uterus (3½ to 4 months) with Distension and Rupture of the Bladder; commencement of Abortion. From a Frozen Section. (Schwyzer.)

[illegible]

[illegible] investment of the [illegible] the organ is partly collapsed [illegible] the over-distended state.

[illegible] —Backward displacement giving rise to [illegible] may be met with accidentally in the second or third month. It usually becomes spontaneously reduced as the uterus develops. When the bladder has become over-distended, spontaneous reposition is impossible. In rare instances no urgent symptoms occur at all even at the critical period—the end of the third month, and the uterus continues [illegible]velopment in its abnormal position, giving rise to the condition known as *sacculation* of the uterus. This has been known to persist until term, and not to interfere with normal delivery. More commonly abortion takes place if the displacement remains uncorrected.

Serious results may ensue if the uterus becomes *incarcerated*. The word 'incarceration' is loosely employed, and has no precise significance, but it may conveniently be used to denote any serious mechanical obstacle to reposition, such as pelvic contraction, especially of the *flat* variety (see p. 285), and peritonitic adhesions involving the uterus, which may have been in existence at the time of conception, or may have developed during the pregnancy. Such cases as these, when unrelieved, may become complicated by (1) rupture of the bladder; (2) cystitis; (3) gangrene and exfoliation of the vesical mucous membrane; (4) uræmia or surgical kidney. With any of these complications prognosis is very grave.

Diagnosis.—The occurrence of marked disturbance of the functions of the bladder in association with three or four months' amenorrhœa should always raise the suspicion of backward displacement of the gravid uterus, and it must be remembered that troublesome frequency of micturition with slight incontinence may be the only symptom to which the over-distended bladder gives rise. Sudden inability to pass water always brings the patient to seek immediate relief; but frequency and slight incontinence when unassociated with pain are often disregarded by her, and sometimes misinterpreted by her medical attendant. Careful abdominal and vaginal examination are required to determine (1) the state of the bladder, (2) the position of the uterus.

On *abdominal* examination an over-distended bladder reveals itself as a soft, non-tender, fluctuating swelling, superficial in position, and reaching well above the umbilicus in extreme cases. Its size alone will serve to distinguish it from the gravid uterus at the third or fourth month. Any doubt will, of course, be dispelled by passing the catheter. Until the bladder has been evacuated, nothing further can be detected on abdominal examination. Signs of activity in the breasts should be noted as being presumptive of pregnancy.

On *vaginal* examination the conditions will be found which are shown in fig. 45. The first point which attracts attention is the forward bulging of the posterior vaginal wall, due to depression of the floor of the pouch of Douglas, and filling up of the sacral hollow by the body of the uterus, which is felt as a smooth, tense, elastic swelling. The next point to be noticed is the inaccessibility of the cervix, which cannot be found at the usual level, but lies high up behind the symphysis pubis. Often the posterior lip alone can be reached, and sometimes the cervix is entirely inaccessible to touch without employing anæsthesia for the examination. The greater the degree of flexion present, the easier will it be to reach the cervix; in a simple retroversion the external os may lie well above the level of the upper border of the symphysis. After evacuation of the bladder the bi-manual examination will show that the swelling felt through the posterior vaginal wall is the gravid uterus, and examination per rectum will allow of much more complete palpation of the displaced uterus than the vaginal examination. Confirmatory signs of pregnancy may be found in softening of the cervix and purple discoloration of the mucous membrane of the vulva. Finally an attempt should be made to estimate the mobility of the uterus, by endeavouring to lift it upwards and forwards in the pelvic axis with the examining finger. The presence of pelvic contraction should not be overlooked as a cause of incarceration; adhesions are very difficult to diagnose, and their presence will not, as a rule, be suspected until it is found that some unexpected obstacle to replacement exists.

Differential Diagnosis.—There are only two conditions which may be said closely to resemble retroversion of the gravid uterus—viz. *pelvic hæmatocele* (almost always due to extra-uterine gestation), and a *fibroid tumour in the posterior uterine wall.* The former will be considered in a subsequent section (see p. 133). With regard to the latter, the differential diagnosis is easy if the fibroid uterus is not gravid, but very difficult if pregnancy has occurred; in the latter case the physical signs may so closely resemble those of a retroverted gravid uterus as to deceive the most experienced clinical observer. The following symptoms usually afford valuable aid in distinguishing these conditions, as may best be indicated in a table thus:

I. Retroverted Gravid Uterus	II. Fibroid in Posterior Wall	III. Fibroid in Posterior Wall + Pregnancy
1. Amenorrhœa	Normal menstruation or menorrhagia	Amenorrhœa or slight irregular hæmorrhage
2. Signs of pregnancy in Breasts (primigravida), Cervix, and Vulva	Occasionally secretion in Breasts No signs of pregnancy in Cervix and Vulva	Signs of pregnancy in Breasts (primigravida), Vulva, and Cervix
3. Retention of urine	Retention of urine	Retention of urine

The great majority of fibroids are hard and quite unlike the gravid uterus in consistence, but sometimes these tumours become softened from œdema or cystic degeneration; and although multiple fibroids cause the outline of the uterus to become irregular, a single interstitial or submucous growth will cause a symmetrical enlargement not unlike that of pregnancy. Softening of the cervix is often delayed when pregnancy occurs in a fibroid uterus (see p. 144). These facts, together with the tendency of fibroids occupying the posterior uterine wall to occasion retention of urine, are the chief causes of the difficulties in diagnosis. The immediate treatment of I. and III. being the same, their differential diagnosis is not of great practical importance.

Other swellings, such as a small ovarian cyst, are not infrequently found occupying the pouch of Douglas and displacing the cervix forwards against the symphysis pubis. They seldom, however, cause retention of urine, for the reason that they do not occasion that elongation of the urethra to which retention is largely due in the case of the retroverted gravid uterus. The differential diagnosis can usually be made by localising the uterus, which will be found to be of normal size and to lie in front of the swelling, and distinct from it. None of the signs or symptoms of pregnancy will be met with.

Treatment.—When backward displacement is discovered early in pregnancy, before the onset of symptoms, it is best to leave matters alone, for spontaneous ascent of the uterus will probably occur before long, while attempts at replacement are likely to cause abortion. After retention of urine has occurred, the essential point in treatment is to evacuate the bladder with the catheter. This may have to be done in the first place for diagnosis. If the patient is kept in bed for a few days and the catheter regularly used three or four times in twenty-four hours, spontaneous ascent of the uterus into its proper position often occurs without anything else being done. In many cases some artificial means of replacement will, however, be required.

Methods of Replacement.—The two chief methods made use of are: (1) manipulation aided by posture, anæsthesia, or prolonged rest; (2) continuous pressure.

(1) *Manipulation.*—The simplest application of this method is to place the patient in Sims's position and, the bladder having been evacuated, to endeavour to push the fundus upwards and forwards in the direction of the axis of the pelvic brim; this may be done with two fingers passed into the vagina, or with the index finger in the vagina and the middle finger in the rectum, which allows of pressure being more effectively applied to the retroverted fundus. Further aid may also be obtained by seizing the posterior lip of the os externum with a volsella and drawing it downwards while the fingers push the fundus upwards. This, however, will not succeed unless the patient is tolerant of pain

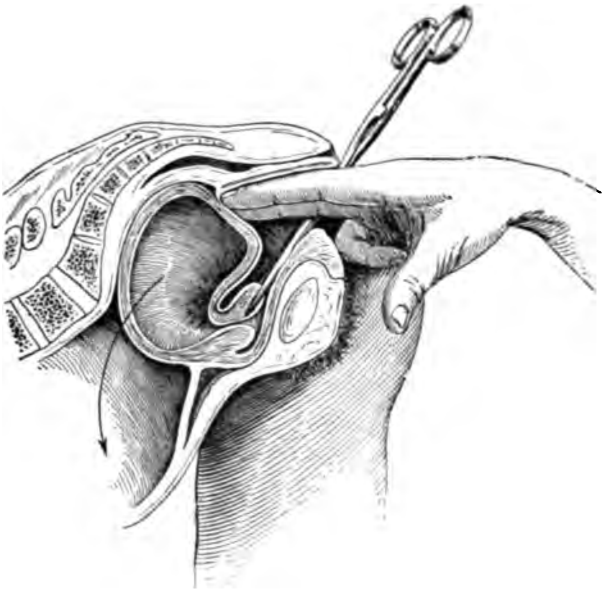

FIG. 46.—REPLACEMENT OF RETROVERTED GRAVID UTERUS BY MANIPULATION IN GENU-PECTORAL POSITION. (BUMM.)

and will avoid straining. When the fundus has been raised above the pelvic brim, the cervix should be pushed back towards the sacral hollow and the body drawn forwards towards the pubes with the external hand. Precisely the same manœuvre may be attempted with the patient in the knee-elbow or the knee-chest (genu-pectoral) position (fig. 46), which brings in the aid of gravity to a greater extent, the uterus tending to fall towards the dependent abdominal walls. If an anæsthetic is administered so as to abolish completely the muscular reflexes, manipulation will often succeed after being employed unsuccessfully without it. The position of the patient is unimportant when under anæsthesia. Even when manipulation fails at first, it may succeed after a few days' rest in bed, aided by saline purgatives and hot vaginal douching.

In Sims's position the patient lies on her left side with the left arm behind her, and both knees drawn up to the abdomen, the right higher than the left. The knee-elbow and knee-chest positions will be more fully described in a later section (see p. 281).

(2) *Continuous Pressure.*—This method is applied by passing into the vagina the hydrostatic dilator known as the Champetier bag (see p. 484), distending it with air or water (preferably the former), and allowing it to remain for a period of six hours at a time. This continuous elastic pressure from below, when applied intermittently for a few days, sometimes succeeds after manipulation has failed, but it causes considerable pain and distress.

Cases which resist these methods of replacement are very uncommon, and are due either to contraction (flattening) of the pelvic brim or to the presence of adhesions. In the former condition spontaneous abortion will in all probability occur; in the latter it is best to allow the gestation to continue to term, when there is good hope of spontaneous delivery taking place.

Anteflexion of the Gravid Uterus.—During the last three or four months of pregnancy, when the uterus is imperfectly supported by the lax abdominal walls so often found in a multipara, the fundus tends to fall forwards, producing unusual protrusion of the abdomen. This may become exaggerated by the uterus passing between the recti muscles, when they have become separated from one another by a distinct interval;

the uterus being then supported only by the cutaneous structures of the abdominal wall, the fundus may come to lie at a lower level than the symphysis pubis, producing the condition called *pendulous belly* (fig. 47). The same condition may result from or be exaggerated by extreme pelvic contraction, preventing the descent of the fœtus into the pelvic brim; or spinal curvature, displacing the uterus forwards. It naturally causes considerable discomfort when the patient is in the erect position, and if uncorrected may lead to rupture of the uterus during labour. Occasionally an atypical form of anteflexion results from previous fixation of the uterus by hysteropexy or vaginal fixation. The *treatment* during pregnancy consists in wearing a strong well-fitting abdominal belt.

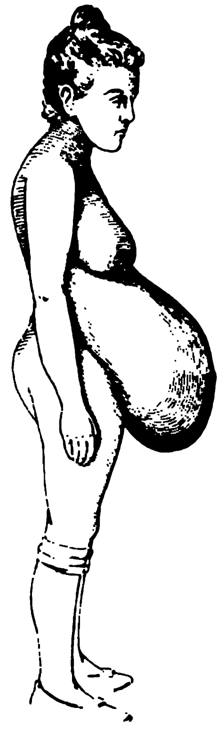

FIG. 47. — ANTEFLEXION OF THE GRAVID UTERUS: PENDULOUS BELLY. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Prolapse of the Gravid Uterus.—A completely prolapsed uterus (procidentia) very rarely becomes gravid. If pregnancy should occur, spontaneous ascent usually takes place about the third month; but the uterus may become 'incarcerated,' when spontaneous abortion will almost inevitably occur. Minor degrees of prolapse of the uterus are frequently met with in pregnancy; they only require treatment during the first three or four months, as after this period the uterus has risen into the abdomen and is supported by the pelvic brim. A ring pessary of suitable size is generally successful.

Hernia of the Gravid Uterus.—Very rarely the uterus forms part of the contents of an inguinal hernia, and in that position it has been known to become gravid. This condition is naturally more likely to affect a bicornute uterus, one horn being drawn into the hernial sac. Sometimes also the gravid uterus may enter the sac of an umbilical or a ventral hernia; but this is rare, as the uterus, by the time it reaches

being caused in the same way as anasarca. *Hæmorrhoids* are often produced or aggravated during the later months of pregnancy. *Cramp* in the muscles of the legs, either spontaneous or when walking, is often very troublesome during the last few weeks, and is probably due to pressure upon the nerves of the lumbo-sacral plexus.

The *treatment* of these pressure-symptoms consists, in the main, of rest in a horizontal position. In cases of œdema careful examination of the urine must of course be made, as, if albumen is present, the aspect of the case is entirely altered. Varicose veins of the vulva do not rupture spontaneously; but from injury during pregnancy, or from laceration in delivery, may give rise to serious hæmorrhage. It is better not to undertake operations upon varicose veins or hæmorrhoids during pregnancy, as continuation of the pressure prevents a satisfactory result.

Uterine Moles

The term 'mole' is applied to an ovum destroyed by pathological conditions affecting its coverings during the early months of gestation. Two kinds are recognised, the *Blood Mole* and the *Hydatidiform Mole*, and both may occur in either uterine or extra-uterine gestation. Moles are often colloquially termed 'False Conceptions.'

I. **The Blood Mole** (Synonyms: Carneous or Fleshy Mole, Hæmatoma Mole). -The blood mole results from the destruction of the ovum by progressive or recurrent hæmorrhage, usually but not invariably occurring before the formation of the placenta—*i.e.* during the first three months of pregnancy. The general structure of the ovum at this period is shown in figs. 9 and 14. It is completely enveloped in the thick, very vascular, decidual membrane; the chorion is separated from this membrane by a narrow space continuous around the whole ovum, termed the chorio-decidual space; this space contains maternal blood and is traversed by the delicate branching villi which spring from the outer surface of the chorion, and some of which are loosely attached by their tips to the decidua (see p. 24). The morbid process starts in hæmorrhage from maternal vessels into the decidual tissues, followed by extravasation of blood into the chorio-decidual space, which will break up and destroy the delicate villi at the affected spot (fig. 49). A sudden and extensive hæmorrhage of this kind would no doubt cause rupture of the decidua capsularis, or complete detachment of the ovum, both of which accidents would quickly lead to abortion. But the blood mole is formed by repeated slight hæmorrhages, or by a single slowly progressive hæmorrhage, which does not cause rupture of the protective decidual covering of the ovum. The effused blood is free to surround the ovum, more or less completely, by following the chorio-decidual space ; hæmorrhage sometimes starts independently at different spots (fig. 49). The result is the more or less complete destruction of the chorionic membrane and its villi. The amnion, being very elastic, is able to resist the external pressure to which it is subjected; consequently the amniotic sac is usually found free from blood in these cases. The fœtus perishes and may be completely absorbed ; sometimes it remains and is found more or less disorganised by maceration in the liquor amnii. Occasionally, however, the amnion is totally destroyed. The effused blood is usually unequally distributed around the ovum, and forms an irregular series of abrupt polypoid elevations (fig. 50), covered by the amnion, with deep intervening sulci; this causes marked distortion and narrowing of the amniotic cavity.

In figs. 49 and 50 two stages in the formation of a blood mole are shown ; the drawings were made from nature in cases of tubal gestation, and therefore they illustrate primarily the mode of formation of a tubal mole ; but the process is probably identical with that which occurs in the uterus. Opportunities of examining a uterine mole *in situ* very seldom occur, but in the case of a tubal mole they are fairly common, as gravid tubes are usually removed by operation. In fig. 49 hæmorrhage has occurred at two distinct areas of the chorio-decidual space ; the effused blood is bounded internally by the unruptured chorionic membrane, and within this by the amnion. As there is little or no decidual formation in the gravid tube, the hæmorrhage appears to be limited externally by the tube-wall. The amniotic sac and the embryo appear to be unaffected. In fig. 50 a later stage of the process is shown. Extensive hæmorrhage has occurred, which entirely surrounds the ovum ; it is limited internally by the amnion alone, and the amniotic sac is small and distorted, but still contains a trace of the body of the embryo; the chorionic membrane has been completely destroyed. Irregular protuberances with intervening sulci are seen on the amniotic aspect. The hæmorrhage is almost entirely maternal in origin; no doubt some admixture of fœtal blood also occurs, but its amount must be inconsiderable, owing to the small size of the embryo at this period. A blood mole discharged in a fresh condition—*i.e.* soon after the occurrence of the hæmorrhage—is sometimes called an *apoplectic ovum*.

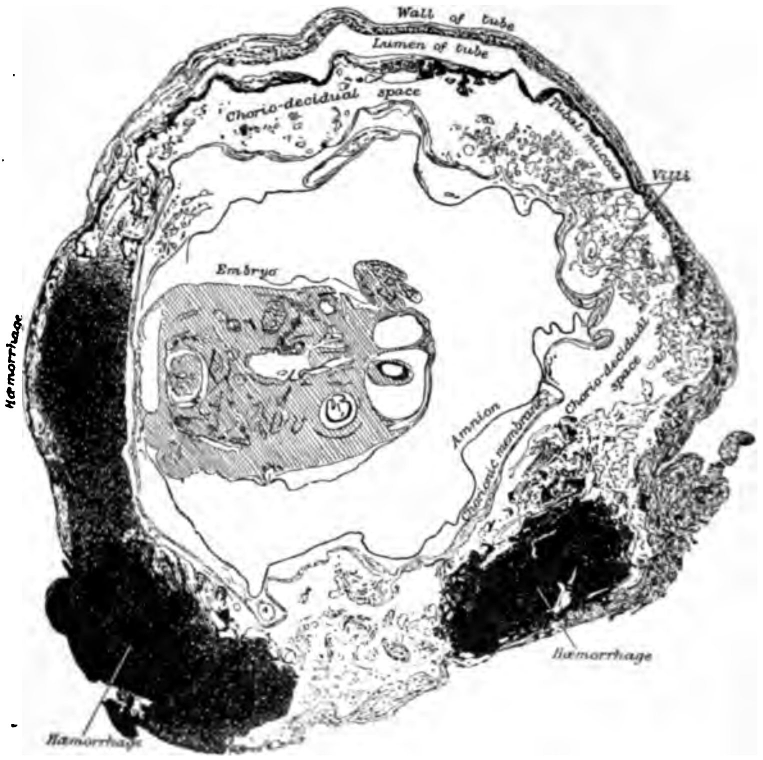

FIG. 49.—TUBAL PREGNANCY : SECTION OF THE OVUM IN SITU, DEMONSTRATING THE EARLY STAGE OF FORMATION OF A BLOOD MOLE. HÆMORRHAGE HAS OCCURRED INTO THE CHORIO-DECIDUAL SPACE, BREAKING UP LARGE NUMBERS OF VILLI. (COUVELAIRE.)

An ovum thus destroyed may be retained *in utero* for many weeks or months; the effused blood then undergoes

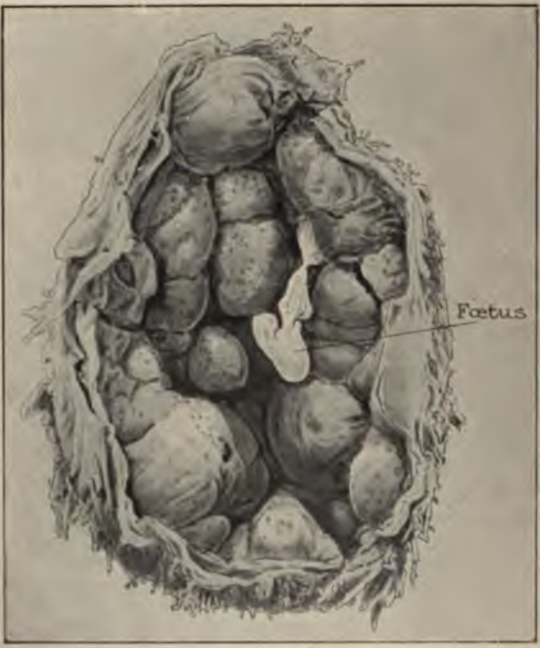

Fig. 51.—Fleshy Mole; Four Weeks' Gestation retained until Seventh Month.

(Charing Cross Hospital Museum.)

[*To face p.* 105.

consolidation from absorption of its fluid constituents, and the wall of the dead ovum becomes firm and 'fleshy' in consistence (carneous or fleshy mole, fig. 51). On section, the wall of the carneous mole is sometimes seen to be partially laminated, indicating that it has been formed by repeated hæmorrhages;

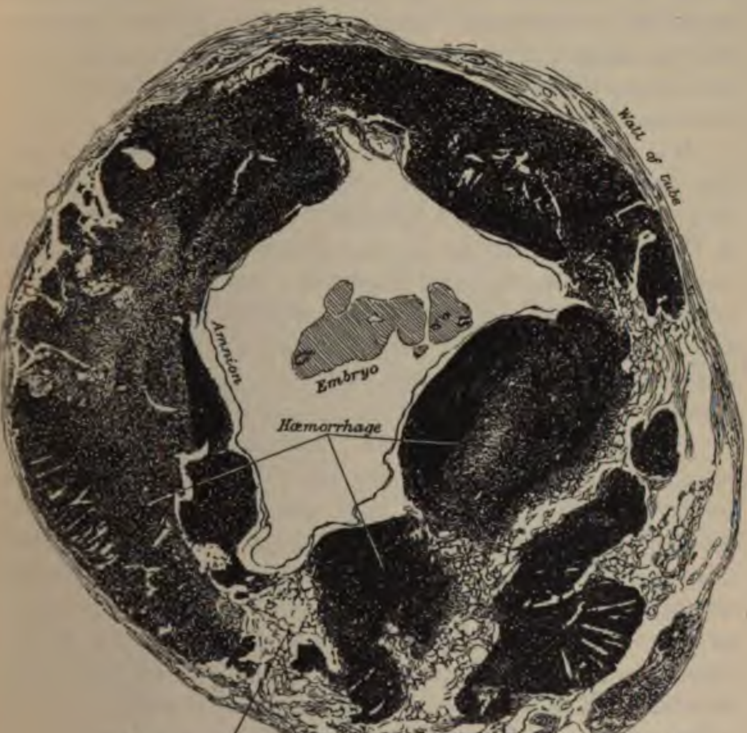

FIG. 50.—TUBAL PREGNANCY: SECTION OF THE OVUM IN SITU, DEMONSTRATING THE LATE STAGE OF FORMATION OF A BLOOD MOLE. (COUVELAIRE.)

sometimes strands of fibrous tissue traversing it can be recognised, indicating remains of the chorion. On microscopic examination degenerated chorionic villi imbedded in blood-clot will be found in it. In a certain number of fleshy moles there is a marked disproportion between the size of the amniotic cavity and the stage of development of the fœtus. This is well shown in fig. 51, where the fœtus measures

8 mm. in length (3–4 weeks), while the amniotic sac measures 2½ in. × 2½ in. (9–10 weeks). This is probably the result of an excessive production of liquor amnii (hydramnios). It is possible that the hydramnios was present in these cases before the formation of the mole began, the hæmorrhagic process being started by the stretching to which the decidua was subjected by the abnormally large ovum. This point is, however, still the subject of dispute, and in any case hydramnios is not to be regarded as an essential factor in the production of a blood mole.

We can only speculate upon the conditions which give rise to hæmorrhage in the early ovum. Syphilis, chronic Bright's disease, and endometritis are believed to be concerned in its production, but upon inconclusive evidence. The great vascularity of the decidual membrane, the imperfect external support furnished to the decidua capsularis at this period, and the delicacy of the young chorionic attachments, make it probable that even in the case of a healthy ovum slight traumatic disturbances may start the process.

The *symptoms* which attend the formation of a uterine mole are indefinite. In most cases a train of symptoms, to be described later on as those of 'threatened abortion,' occur, which subside, and then nothing else is noted until the ovum is cast off. This event, which may take place within a few weeks or be delayed for many months, is known as a 'missed abortion.' The process does not differ in any respect from that subsequently to be described as 'inevitable abortion.' The *diagnosis* is naturally a matter of some difficulty, and can really only be solved by the expulsion of the mole. Interference is seldom required, but if the uterine discharge should become offensive (putrefaction of the ovum), the treatment consists in dilating the cervix and clearing out the uterine contents in the manner described under induction of abortion.

II. **The Hydatidiform Mole** (Synonym: Vesicular or Hydatidiform Degeneration of the Chorion).—This condition is a disease of young chorionic villi, characterised by the formation of immense numbers of irregular clusters and chains of cysts which vary in size from extreme minuteness up to four-fifths of an inch in diameter. Cases have, however, been recorded in which the largest vesicles measured 1½ inch in long diameter. The superficial resemblance of these cysts to hydatids originated the name by which this condition is known, but it must be understood that the hydatidiform mole has really nothing in common with echinococcal cystic disease. The naked-eye appearance of this mole is so characteristic that its recognition is very easy (fig. 52). Sometimes, as in this figure, the cysts are developed equally from the external surface of the whole chorionic membrane, and the amniotic cavity may then be preserved with traces of the fœtus; more frequently the change is irregularly distributed, the general contour of the ovum becomes completely lost, and the mole consists of a shapeless mass of vesicles without any definite arrangement, the amniotic sac and fœtus having entirely

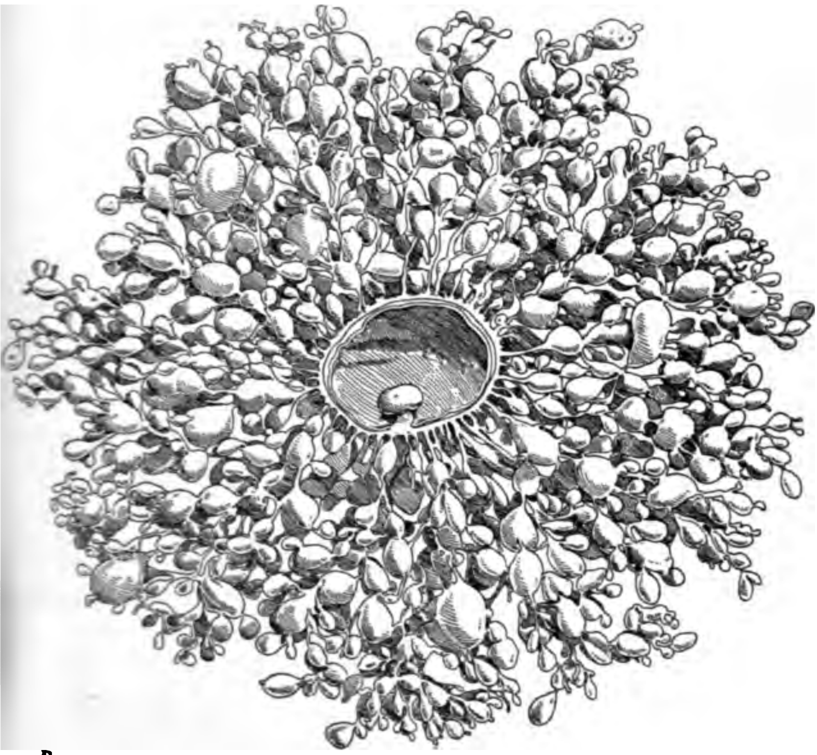

Fig. 52.—Hydatidiform Mole (diagrammatic): the entire Chorion is affected by the Disease; the Amniotic Sac is seen in the Centre. (Bumm.)

disappeared. It is not uncommon for the mole to weigh as much as four or five pounds. The disease generally begins before the formation of the placenta, at a period when the whole chorion is villous; when it begins later it is usually partial, affecting a portion only of the placenta. This is well illustrated in fig. 53, which represents a placenta infiltrated by hæmorrhage and partially affected by vesicular degeneration. A considerable number of instances have now been recorded in cases of extra-uterine gestation. The vesicles themselves are thin-walled, contain clear fluid, and are connected with one another by delicate stalks.

The microscopic characters of the vesicles present the curious association of abnormally active proliferation of both the syncytial and cellular layers of the chorionic epithelium, with degeneration of the connective-tissue stroma. The vesicles all possess a complete epithelial wall. In the larger vesicles the stroma and the blood-vessels are completely destroyed, and only a few degenerated nuclei persist; the contents are entirely fluid. In smaller vesicles a layer of altered and compressed connective tissue may be found immediately under the epithelium, the centre of the vesicle containing only fluid (fig. 54). Mucoid (myxomatous) degeneration was originally supposed to be the nature of these changes in the stroma, but it has now been established that the fluid found in the vesicles contains no mucin; some form of dropsical degeneration is therefore the probable cause. The epithelial covering of all sizes of vesicles shows remarkably active proliferation of the syncytial layer. In fig. 54 are seen numerous buds and processes springing from the syncytium, and also isolated sections of such processes springing from neighbouring villi (syncytial buds). The change in both the epithelium and the stroma will be best appreciated by comparing fig. 54 with fig. 16, representing the same structures in young normal villi. Unusually active proliferation of the cells of Langhans is also generally found.

An important result of this abnormal activity on the part of the chorionic epithelium is that the degenerated villi possess powers of penetrating the uterine wall which exceed those of normal villi. The eroding properties of this tissue have been already referred to in connection with the normal ovum. All hydatidiform moles possess this property to an

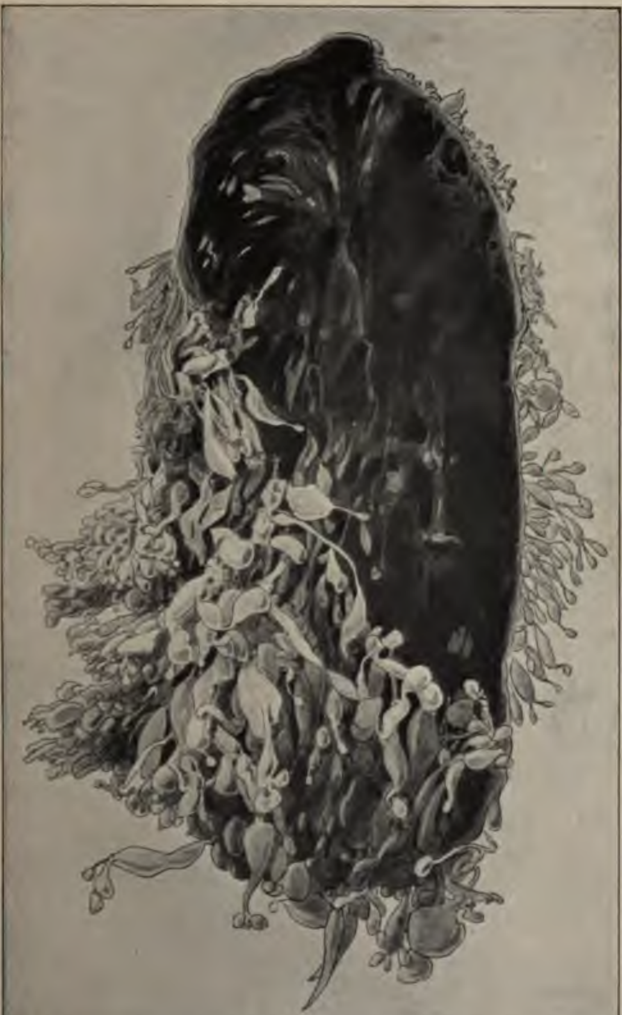

FIG. 53.—PLACENTA WITH EXTENSIVE HÆMORRHAGE, AND VESICULAR DEGENERATION OF THE CHORIONIC VILLI.

(CHARING CROSS HOSPITAL MUSEUM.)

Note the cysts imbedded in blood-clot.

[*To face p.* 108.

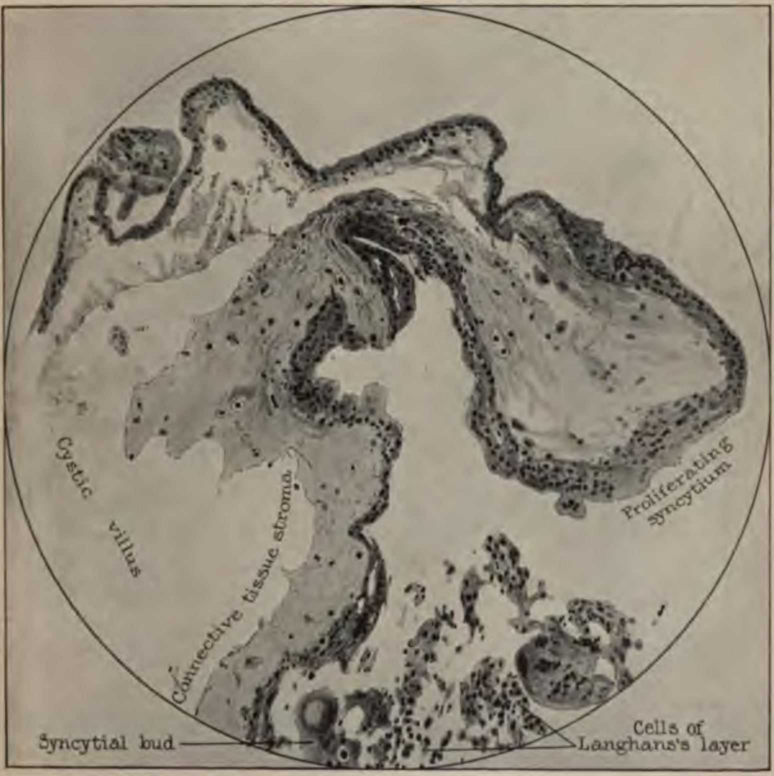

FIG. 54.—HYDATIDIFORM MOLE:
SECTION THROUGH A PORTION OF A CYSTIC VILLUS.

[*To face p.* 108.

unusual extent; but in some of them the infiltrating power of the diseased tissues is so great as to cause spontaneous perforation of the uterine wall, leading usually to death from hæmorrhage or peritonitis. This variety is known as the *perforating* or *malignant hydatidiform mole*; it is closely allied in histological characters to chorion-epithelioma (deciduoma malignum), and is frequently followed after an interval by the appearance of this formidable new-growth (see p. 441). The property of invading healthy tissues is one of the chief characteristics of malignant disease, and quite justifies the term 'malignant' being applied to this form of mole. With the remarkable activity of the chorionic epithelium must be contrasted the fact that the degenerated villi are completely devascularised and the embryo destroyed.

Nothing is definitely known as to the causation of the hydatidiform mole, though there has been much speculation about it. Some authorities believe that an unhealthy condition of the decidua induces the morbid change in the chorion, but the majority consider that it arises primarily in the chorion itself. It appears to be more reasonable to regard it as an embryonic disease, and this view is supported by the fact that in twin pregnancy it sometimes affects one ovum only. If the cause lay in the decidua, both ova would certainly be affected. It may occur at any time in the reproductive period, but is most commonly met with in the decennial periods 20–30 and 40–50. It is a distinctly rare condition, occurring probably in about 1 in 2,000 to 2,500 pregnancies.

Clinical Features.—Two symptoms, which arise in the first half of pregnancy, are invariably met with in this condition: (1) undue enlargement of the uterus; (2) hæmorrhagic discharge.

(1) The size of the uterus is out of proportion to the presumptive period of pregnancy: thus the fundus may extend up to the umbilicus three months after the cessation of the last regular monthly period; a less pronounced disparity than this is, however, more common. But it must be remembered that over-enlargement of the uterus at the third or fourth month may occur from other causes. The large uterus occupies the normal position of the gravid womb; in exceptional cases it has been described as extending up to the

ensiform cartilage; it possesses a peculiar doughy consistence. It is exceptional for the fœtal heart-sounds to be heard, even when the uterus is of the size of six or seven months' pregnancy, because, except in rare instances, there is no fœtus. Vesicular degeneration sometimes, however, in a twin pregnancy affects one ovum only, and then of course the heart of the surviving fœtus may be heard. As a rule the uterine souffle cannot be detected.

(2) The discharge usually appears during the third or fourth month. It is commonly small in amount, more or less continuous, thin and watery in character, reddish or reddish-brown in colour, and unattended by pain. Severe hæmorrhage is very rarely met with except during the process of abortion. In rare instances the discharge may possess characters which are pathognomonic, detached vesicles being found in it; but this is uncommon and must not be anticipated. Sometimes the discharge solidifies, forming a red jelly in which pale vesicles may be found.

The over-enlargement of the uterus is of course due to the bulk of the diseased ovum, which may be enormous; its peculiar consistence is due to the absence of the amniotic fluid sac, which gives to the normal gravid uterus its characteristic elasticity. The hæmorrhage is probably occasioned by the detachment of vesicles from the uterine wall, and by rupture of vesicles; the discharge therefore consists partly of maternal blood and partly of the fluid contents of ruptured vesicles. After the hæmorrhage has persisted for a variable period, spontaneous abortion almost always occurs.

Diagnosis is often uncertain, and can only be settled by the discovery of vesicles; if none are discharged spontaneously, the finger may sometimes feel them in the cervical canal if the internal os is a little dilated. In the absence of this sign it may be said that marked over-enlargement of the uterus, with persistent or repeated hæmorrhage at the third or fourth month of pregnancy, is suggestive of a hydatidiform mole.

Treatment.—This consists in all cases in artificial evacuation of the uterus. Spontaneous abortion of an hydatidiform mole is a very long and tedious process, resulting in considerable hæmorrhage; being almost invariably incomplete, it must be terminated by interference. The uterus in these cases appears to be unable to expel its contents, and it is therefore best, when the diagnosis has been made, to evacuate it without delay. This procedure is fully described in connection with the process of abortion (p. 159). The cervix may be dilated either by tents or metal dilators (see fig. 77), and the contents of the uterus then gradually removed with the fingers. What seems at first, on account of the size of the uterus, a task almost impossible for the fingers alone, becomes easier as the process advances, the uterus gradually diminishing in size so as to bring the fundus within reach. Ovum forceps or curette are unnecessary, and even in experienced hands their use may lead to perforation of the uterine wall. Care should be taken to detach all the vesicles from every part, and the uterine cavity should then be thoroughly douched with a weak antiseptic solution and, if retraction is unsatisfactory, packed with iodoform gauze. There are special risks in the puerperium of sepsis, sub-involution, and, remotely, of the development of chorionepithelioma.

Decidual Endometritis

Acute decidual endometritis has been observed in cases of ascending gonorrhœa in pregnant women, the gonococcus having been demonstrated in the decidual membrane. So far as we know, this is the only variety of acute inflammation of the decidua arising spontaneously during pregnancy; but acute septic inflammation from operative interference may, of course, also be met with. *Chronic* decidual endometritis is more common, and is believed to result from implantation of the ovum upon an unhealthy endometrium. The membrane is unusually thick and fleshy, and often shows numerous small cysts beneath the epithelium, which arise from irregular dilatation of the deep parts of the uterine glands. Although decidual endometritis is undoubtedly a genuine cause of abortion, its clinical recognition is impossible in the present state of our knowledge; diagnosis can only be made from examination of the membrane after its discharge from the uterus.

Hydrorrhœa Gravidarum and Decidual Endometritis.—Hydrorrhœa gravidarum is the term applied to a condition in which a discharge of watery fluid from the gravid uterus occurs intermittently in considerable amount, from the second or third month of pregnancy, and may continue to term. It is a rare condition, and is often associated with fœtal malformation. No satisfactory explanation of its occurrence has ever been advanced, and the fluid has usually been supposed to be liquor amnii, or an adventitious fluid secreted between chorion and amnion or chorion and decidua, and discharged from time to time by rupture of the external membrane. Decidual endometritis appears to offer the better explanation. A reference to figs. 30 and 31 will recall the fact that in the lower part of the early gravid uterus there is a small cavity bounded on all sides by decidua, and termed the *decidual space*. In decidual endometritis a watery fluid such as that of hydrorrhœa may possibly be secreted, which accumulates in this space and is discharged from time to time through the cervix when the amount becomes large. The existence of pockets of fluid in this position has been recently demonstrated by Duclos in the uterus of a woman who died during pregnancy and had suffered from hydrorrhœa with slight hæmorrhage. Normally the decidual space becomes obliterated by fusion of the decidua vera and decidua capsularis at the end of the fourth month, but when the membranes are unhealthy their fusion may be delayed or prevented ; the decidual space may then persist and the hydrorrhœa continue until term. The expelling force may be considered to be uterine contractions of unusual power, reflexly excited by the presence of the accumulating fluid. The condition is not amenable to treatment of any kind.

Diseases of the Membranes, Placenta, and Fœtus

Hydramnios (Synonym: Polyhydramnios).—This condition consists in the formation of an excess of liquor amnii. The amount of liquor amnii which may be regarded as normal varies considerably (p. 30) ; it is probable that only quantities exceeding four pints would be clinically recognisable as hydramnios. The fluid shows no abnormal characters, but it may attain the enormous bulk of six gallons.

The *causation* of hydramnios is obscure, and as usual opposing theories have been advanced to explain it, some authorities regarding it as maternal, others as fœtal in origin. The following considerations make it probable that the latter is the true explanation: (1) the mother is usually healthy; (2) the fœtus is frequently deformed, or shows some abnormality of development; (3) it may affect one ovum only in twin pregnancy; (4) the liquor amnii is certainly an embryonic product when first formed in the ovum. Excess of liquor amnii may, however, be associated with maternal dropsy from cardiac or hepatic disease, and in such circumstances it is probable that the condition is of maternal origin. If its usual origin from fœtal, not maternal sources, is admitted, there are still other questions which remain unsettled. Thus it may be caused by increased production or by diminished re-absorption of fluid; if the former, the fluid may be secreted by the amnion or derived from the fœtus by transudation through the skin or through the large umbilical vessels on the placental surface. Hydramnios is more common in multiparæ than primigravidæ; in 75 per cent. of cases the fœtus is of the female sex; and it has been observed in extra-uterine gestation.

As usually met with, hydramnios is a *chronic* condition which does not make its appearance until the fourth or fifth month of pregnancy, and is slowly progressive. Occasionally, however, it assumes an *acute* form, an enormous quantity of fluid being formed within a few weeks. The symptoms to which it gives rise are due to the size of the uterus; when the enlargement has occurred rapidly, as in the acute form, the symptoms are correspondingly severe; in the chronic form much greater toleration of the large uterus is met with. The symptoms are œdema of the lower extremities and vulva, and embarrassment of the respiratory and cardiac functions leading to dyspnœa, palpitations, and cyanosis. Labour usually comes on prematurely.

The physical signs yielded by the uterus in a case of well-marked hydramnios differ from those of the normal gravid uterus as follows: (1) its size is disproportionately large; (2) a fluid thrill may easily be obtained in all directions; (3) frequently the presence of the fœtus cannot be recognised either by palpation or auscultation. Signs of pregnancy will, however, be found in the active condition of the mammary glands (primigravidæ), the characteristic softening of the cervix, and a history of several months' amenorrhœa. These points should deter an observer from attributing the abdominal swelling to an ovarian cyst or to ascites. A large ovarian cyst may be occasionally associated with pregnancy; the differential diagnosis from hydramnios is then more difficult, and will depend upon the recognition in the former of two distinct abdominal swellings, together with the presumptive signs of pregnancy; the physical signs of one of the abdominal swellings will correspond with those of the normal gravid uterus.

There are no means known to us of controlling the production or absorption of liquor amnii, and this condition is therefore not amenable to treatment. If the pressure-symptoms become severe, premature labour must be provoked; this is more likely to be required in the acute than in the chronic form. The weakening of the uterine muscle from over-distension leads to uterine inertia and its attendant risks in labour (p. 320).

Oligo-hydramnios.—In this condition the liquor amnii is deficient in amount, and there may be only a few ounces of fluid in the amniotic sac. Its causation is unknown, and it does not give rise to any maternal symptoms. The fœtus may show various deformities caused by amniotic adhesions.

Amniotic adhesions consist in the formation of intimate adhesions between the amniotic membrane and some part of the skin of the fœtus. Occurring upon the scalp, encephalocele may result; when surrounding a limb, strangulation followed by spontaneous amputation may occur; sometimes the adhesion may strangulate the cord, causing the death of the fœtus. Amniotic adhesions, while usually associated with deficiency of liquor amnii, sometimes occur when the amount of fluid is normal.

Diseases of the Placenta.—Comparatively little progress has been made with the study of the morbid conditions of the placenta, for the reason that the normal structure of the organ at different periods of gestation has only recently been systematically worked out. Most of the earlier accounts of placental diseases must be rejected because the writers were ignorant of these fundamental details. Thus 'placentitis' was at one time thought to be a lesion of frequent occurrence, but it is now known that inflammation rarely, if ever, occurs in the placenta; again, conditions such as 'infarctions,' which were once regarded as syphilitic gummata, are now known to be non-syphilitic.

Anomalies of Size and Shape.—The placenta is sometimes divided unequally into lobes or segments, which are united by large vessels (umbilical) running in the membranes which connect them. There may be two lobes (*placenta bipartita*) (fig. 55), three lobes (*placenta tripartita*), or more than three (*placenta multiloba*). More important than these is another variety of divided placenta, called the *placenta succenturiata* (figs. 43 and 56). In this form one or two small outlying portions of placenta, circular or oval in shape, are present; they are connected with the main placenta by small vessels running in the membranes, and are very liable to be left in the uterus after labour; they may thus give rise to post-partum hæmorrhage, and (indirectly) in the puerperium to septic troubles. Very rarely the placenta is formed over the whole area of the chorion, the usual differentiation into chorion frondosum and chorion læve not being produced. This

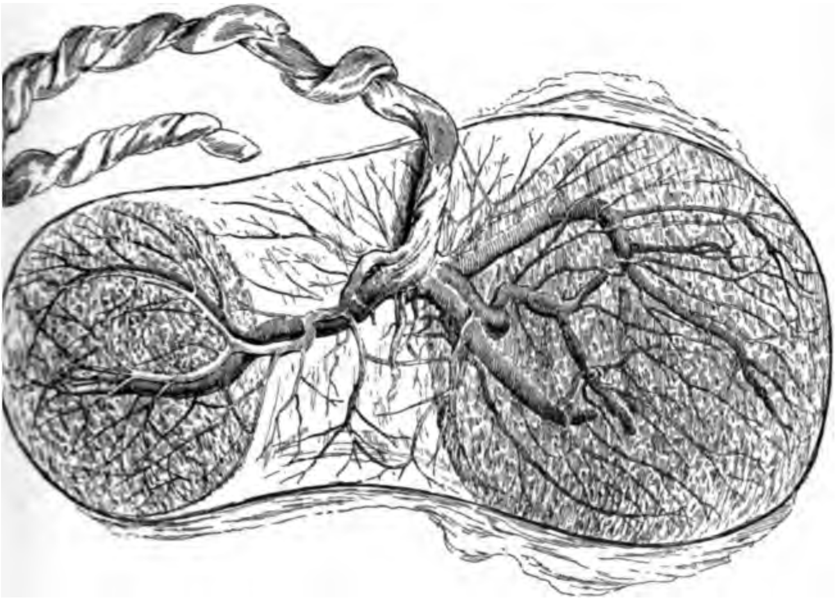

FIG. 55.—PLACENTA BIPARTITA.

Note the bifurcation of the umbilical vessels at the point of insertion of the cord.

is known as the *placenta diffusa*: it is the natural form in certain animals—*e.g.* the sow and the mare.

Anomalies of the Umbilical Insertion.—The cord is usually attached to the placenta about its centre; but the insertion may be excentric, lateral, or marginal, the latter being called the *battledore placenta* (fig. 57). More important practically is the comparatively rare anomaly of the insertion of the cord into the membranes altogether outside the placental margin—the *velamentous placenta* (fig. 58). Very large vessels, constituting the primary divisions of the umbilical arteries and vein, then run beneath the amnion, from

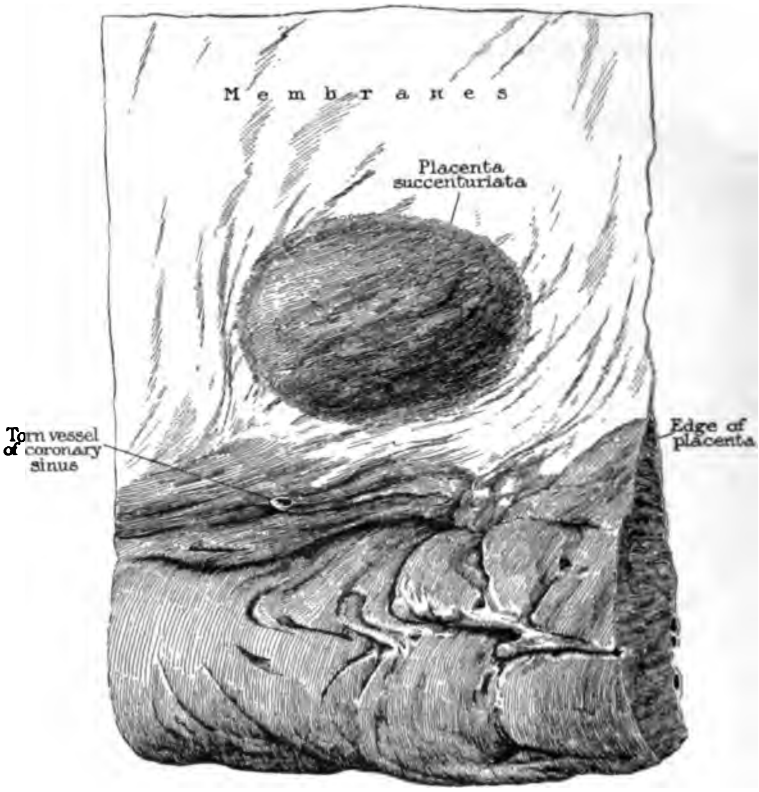

FIG. 56.—A PORTION OF PLACENTA AND MEMBRANES, SHOWING A SMALL PLACENTA SUCCENTURIATA.
(CHARING CROSS HOSPITAL MUSEUM.)

the point of insertion to the placental margin, and are liable to become injured during labour by compression, or by rupture of the membranes which enclose them. The latter accident is only liable to occur when these vessels are situated in the position where the membranes rupture at the end of the second stage of labour.

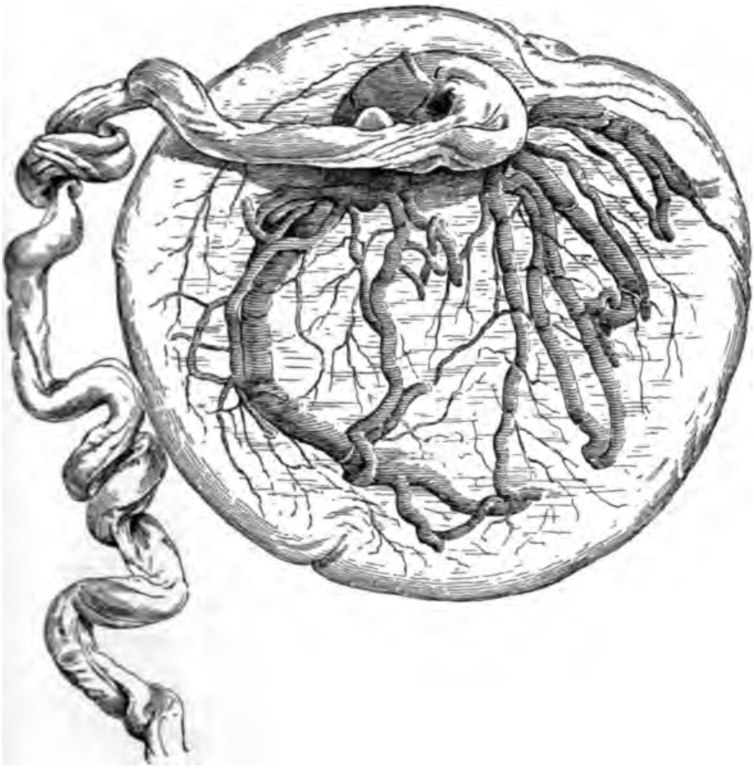

FIG. 57.—BATTLEDORE PLACENTA.
The umbilical cord is inserted close to the placental margin.

Pathological Infarction of the Placenta.—It has been already stated that, during the last two months of intra-uterine life, certain age-changes occur in the fœtal portion of the placenta which result in the formation of small solid bodies, termed 'infarcts,' in the spongy placental substance (p. 29). In connection with the albuminuria of pregnancy, and with chronic nephritis in pregnancy, changes of a similar nature, but much more extensive and occurring earlier in gestation, are met with. These changes are probably important factors in the causation of the heavy fœtal mortality which attends these disorders. In such cases recent hæmorrhages into the placental substance are also often found, and are probably due to rupture of vessels in the decidua.

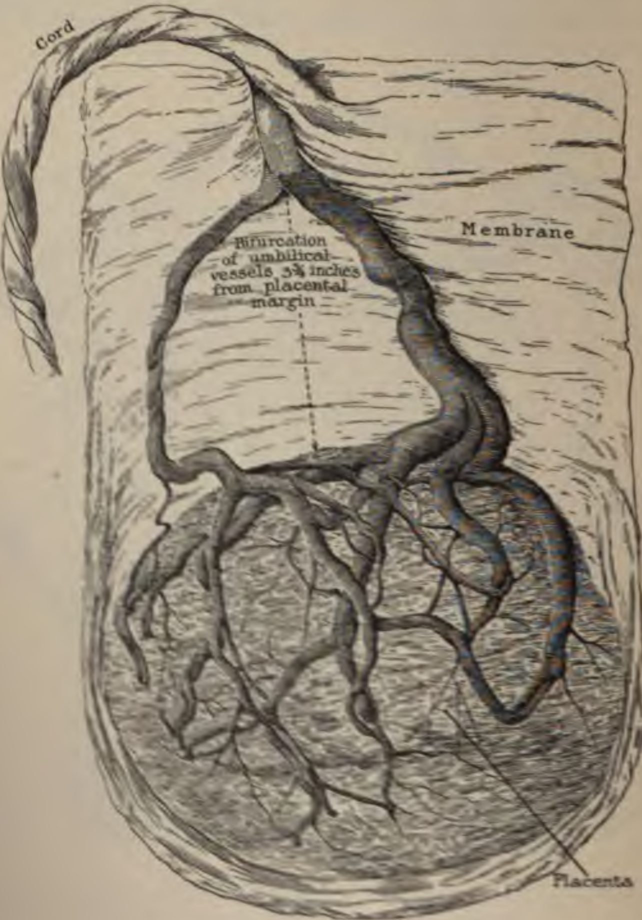
Cord
Membrane
Bifurcation of umbilical vessels 3¾ inches from placental margin
Placenta

FIG. 38.—VELAMENTOUS PLACENTA.
The amnion has been stripped off.

Degeneration of the Placenta.—Fatty, calcareous, and cystic degenerations are often met with in the placenta.

Fatty and calcareous degenerations are usually combined, and are constantly found in infarcted areas; it is probably true that primary fatty degeneration does not exist in the placenta, and in no circumstances is it directly related to syphilis. Extensive calcareous degeneration of the uterine surface of the placenta is common when gestation has been unduly prolonged (post-maturity). Cystic degeneration results in the formation of small sub-amniotic cysts upon the fœtal surface of the placenta. They are frequently multiple; they are never large, and do not affect the functional activity of the organ. Hydatidiform degeneration has been already described.

Tubercle of the Placenta is very rare, but it has been shown to occur occasionally in women affected with acute general tuberculosis or advanced chronic phthisis.

Solid tumours of the Placenta are extremely rare, the greater number of those described being myxo-fibromata.

Hæmorrhage and *Œdema* also occur in the placenta. We know little of the causation of the former; the latter is always associated with general œdema of the fœtus—one of the rarest varieties of intra-uterine disease.

'*Placental Syphilis.*'—In 1873 Fraenkel endeavoured to prove that definite syphilitic lesions occurred in the placenta; that the disease appeared in the chorionic villi when the father was infected, and in the decidua when the mother was infected. Syphilitic villi he described as of unusually large size from proliferation of the connective-tissue stroma, with obliterated vessels, and extensive fatty degeneration of all the tissues. The decidua he described as thickened from hyperplasia. His conclusions have been traversed by many observers, and have never been satisfactorily confirmed.

Fresh interest has been recently excited in this subject by Schaudinn's discovery of an organism—the *spirochæte pallida*—which he believed to be always present in syphilitic lesions, even if it is not the actual parasitic cause of the disease. Since then the organism has been found by many observers in the placental and fœtal tissues in cases of supposed congenital syphilis. Doubt has been thrown upon Schaudinn's work by Schulze and Saling, who assert that nerve fibrils have been mistaken by him for the filaments of which the organism consists. Here the matter must be allowed to rest for the present until the histological question is settled.

Abnormal Conditions of the Fœtus.—The fœtus may be the subject of many abnormal conditions, arising from disease or from errors of development. In a certain number of instances disease is transmitted from one or other parent, usually the mother; in others disease arises spontaneously in intra-uterine life. Very few of these abnormal conditions are of clinical importance. A certain number of developmental errors, however, give rise to difficulty in labour, and will be referred to again in that connection; among these may be mentioned double monsters, hydrocephalus, ascites, abdominal tumours (usually cystic), and general dropsy. Abnormalities of development do not, as a rule, influence the course of pregnancy. The following diseases have been shown to be capable of transmission from the mother to the fœtus: *variola*, *scarlatina*, *malaria*, *morbilli*, *erysipelas*, and *syphilis*; the appearances characteristic of these diseases may be present at birth, or may arise after delivery if the child survives. Further, in the case of *tubercle*, *enteric fever*, *anthrax*, *erysipelas*, *sepsis*, and *diphtheria*, the specific organism has been found in the fœtal tissues, but not the local lesions characteristic of these diseases in the adult; strictly speaking, these diseases are therefore not transmitted, the cause of the death of the fœtus under such circumstances being probably septicæmia. Syphilis may be transmitted from either parent; usually, however, it is paternal in origin. The following are the chief signs of fœtal syphilis as seen in a fœtus which has perished from this disease *in utero*: a bullous eruption (pemphigus), seen especially upon the palms and soles; gummata in the liver and spleen; and in the long bones hyperplasia of the cartilaginous elements along the line of junction of the shaft with the epiphysis—so-called *syphilitic epiphysitis*.

Extra-uterine (Ectopic) Gestation

It is now well established that a fertilised ovum may become implanted not only in the uterus, but in the Fallopian tube, or in the ovary; in the two last-named positions the pregnancy is called extra-uterine or ectopic. The implantation of a fertilised ovum upon the peritoneum—*primary peritoneal pregnancy*—has not yet been satisfactorily demonstrated, although a number of supposed instances have been recorded.

Ovarian Pregnancy.—It is only within recent years that the occurrence of ovarian pregnancy has been satisfactorily proved, and the number of cases which can be accepted as reliable instances of the condition is small. There can be no doubt that it is very much less frequent than tubal pregnancy. In most cases the site of implantation appears to have been a ruptured Graafian follicle. It is, however, possible that the ovum may be impregnated when lying upon the surface of the ovary after its discharge from the follicle, and by its remarkable powers of erosion may excavate a bed for itself in the ovarian tissues. Generally, however, the spermatozoa enter a ruptured Graafian follicle, and fertilise an ovum therein which has not been discharged along with the fluid contents

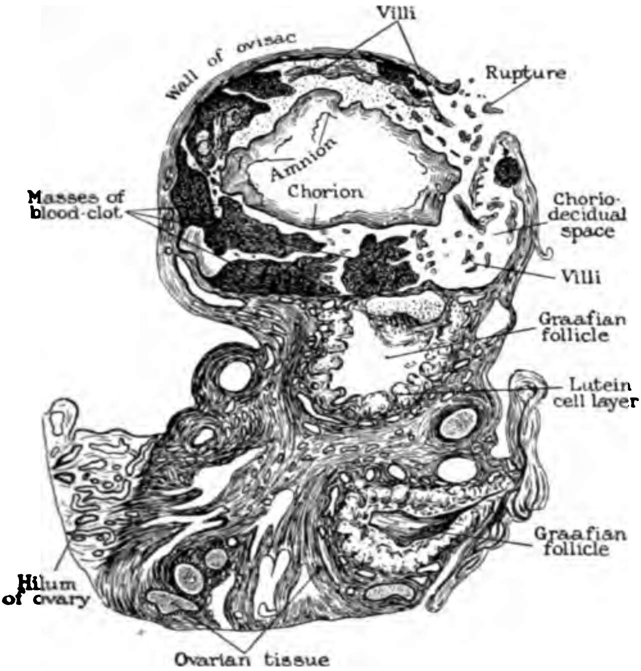

FIG. 59.—OVARIAN PREGNANCY. (VAN TUSSENBROEK.)

of the follicle. In the lutein cells which line the follicle the ovum finds its nidus, and the early stages of development pursue a normal course. Fig. 59 shows the formation of the *gestation-sac* or maternal covering of the ovum; this consists simply of the layers of tissue which normally compose the wall of the Graafian follicle (tunica interna and tunica externa), and it will be seen that the greater part of the ovum is unsupported except by this delicate follicular wall. There appears to be no true decidual formation in the ovary, although large cells have been found by some observers and regarded by them as decidual. In all the authentic cases pregnancy terminated at an early period by rupture, and it seems improbable that this form of gestation can continue for more than a few weeks. Its differential diagnosis from tubal pregnancy is impracticable in the present state of our knowledge, careful examination of the complete specimen, after removal, being required to determine its true nature.

Tubal Pregnancy.—The lodgment of a fertilised ovum in the Fallopian tube is not uncommon, and its frequency is estimated by some writers at 2 to 3 per cent. of all pregnancies. The causes of the arrest of the ovum in the tube on its journey to the uterus are unknown, most of the older explanations having been disproved, or abandoned from lack of supporting evidence. It is known, however, that diverticula of the tubal canal are sometimes found running up into the fibro-muscular wall of the tube; it is possible therefore that an ovum, either before or after being fertilised, may wander into one of these *impasses* and, being detained there, may become engrafted upon the mucous membrane, which has the same structure as that of the tube proper. The view that arrest of the ovum in the tube may be due to such morbid conditions as desquamative salpingitis, or occlusion of the tubal lumen by adhesions, has not received support from morbid anatomy, and must be abandoned. Age and social conditions do not influence its occurrence; it may be met with in a first or any subsequent pregnancy, and in the latter case it may follow normal gestation after an interval varying from a few months to many years. Tubal pregnancy is in all probability to be regarded as an accidental occurrence; it is a morbid condition only in the sense of involving both the mother and the ovum in serious risks. Most frequently the fertilised ovum lodges in the *ampulla* of the tube, more rarely in the *isthmus*, and least frequently of all in the *interstitial* portion.

Anatomy.—Tubal pregnancy gives rise to a series of well-marked changes in the uterus, and in the affected Fallopian tube; the former are uniform and constant, the latter vary with the location of the ovum. The *uterus* always shows a certain amount of enlargement, accompanied with softening of its walls and of the cervix; both are recognisable clinically, the softening of the lips of the external os being readily found. The endometrium is completely converted into a decidual membrane indistinguishable from the decidua vera of normal uterine pregnancy. This change has been spoken of by Webster as the 'decidual reaction' of the uterus. In the affected *tube* the changes are mainly confined to the neighbourhood of the ovum, more distant parts showing practically no changes recognisable with the naked eye. The portion of the tube which encloses the ovum is usually called the gestation-sac.

It has recently been shown that, when lodged in the tube, the fertilised ovum buries itself in the maternal tissues very much in the same manner as in uterine pregnancy (see p. 15). The mucous membrane of the tube undergoes no preparatory thickening as probably does the endometrium; penetration of the tissues is easy, and the ovum appears in some cases, if not in all, actually to reach the muscular coat and become completely imbedded in it. The ovum thus develops, for a time at any rate, in a cavity hollowed out of the substance of the tube-wall and practically shut off from the tube-lumen. This arrangement compensates, to some extent, for the absence of a complete decidual investment, and renders the early lodgment of the ovum more secure. The formation of the embryo and of the embryonic coverings of course proceeds in the manner already described for uterine pregnancy. At the site of the growing ovum the tube undergoes rapid distension and assumes a somewhat oval form. The wall of the distended portion becomes considerably thinned; this thinning is due in part to the absence of compensatory muscular hypertrophy such as takes place in the gravid uterus, and in part to the eroding action of the chorion, which penetrates the tissues, and so further thins the wall. No true formation of a decidua occurs in the tube, although it has been demonstrated that clusters of large 'decidual' cells may be found here and there in the mucous membrane of both the affected and the unaffected tubes. When the ovum lodges in the ampullary portion, the abdominal ostium almost invariably becomes occluded before the end of the second month (eighth week); when the ovum lies in the isthmus or the interstitial portion the abdominal ostium does not close (fig. 60). The condition of the ostium, as will appear later, has an important clinical bearing. A gravid tube is usually found, on opening the abdomen, to have contracted adhesions to surrounding structures; and at spots where the penetrating villi have reached, or nearly reached, the peritoneal coat, thick layers of lymph become deposited, the effect of which is to strengthen the weak spot.

From this account it is obvious that the ability of the Fallopian tube to continue to accommodate the growing ovum is by no means certain; as a matter of fact it fails to do so except in extremely rare instances. It is, however, believed that genuine cases are on record of gestation continuing to term, or nearly to term, in an unruptured Fallopian tube. Failing this event, either the ovum is destroyed, or it escapes from its cramped surroundings and pursues its development under more favourable circumstances. The ovum may be destroyed *in situ* by hæmorrhage which converts it into a *tubal mole*; or it may be detached from its base and expelled either through the patent abdominal ostium (*tubal abortion*), or through a rent in the wall of the tube (*tubal rupture*). In some instances rupture occurs without causing complete detachment of the ovum; its existence is not then necessarily terminated, for development may proceed in the freer space thus gained for it.

The Tubal Mole.—The mode of formation of a tubal mole is well shown in fig. 61, which represents a transverse section through a gravid Fallopian tube at the site of implantation of the ovum. The lumen of the tube is occupied by an oval mass of blood-clot in which many villi lie imbedded; a cavity of irregular shape, representing the amniotic sac, is seen, placed somewhat excentrically in the midst of the blood-clot. There is no appreciable thinning of the wall of the tube except at the right of the figure, where chorionic villi can be seen to have penetrated nearly as far as the peritoneal

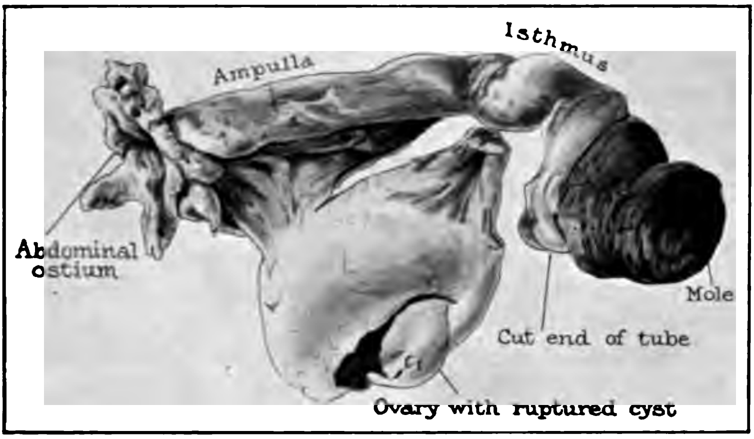

FIG. 60.—TUBAL PREGNANCY (FOUR TO FIVE WEEKS) IN ISTHMIAL PORTION: RUPTURE AND EXTRUSION OF A TUBAL MOLE.

(CHARING CROSS HOSPITAL MUSEUM.)

The abdominal ostium is patent, and the distal portion of the tube unchanged.

[*To face p.* 124.

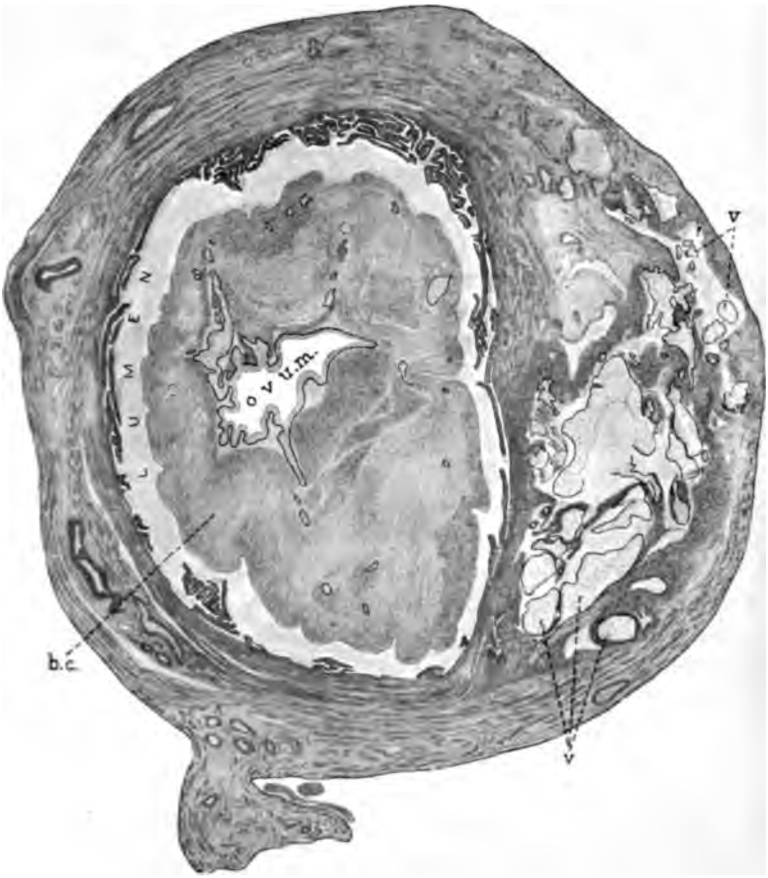

FIG. 61.—EARLY TUBAL PREGNANCY, SHOWING MODE OF FORMATION OF A TUBAL MOLE, AND EROSION OF THE TUBE-WALL BY VILLI. (WHITRIDGE WILLIAMS.)

b.c., blood-clot; v. chorionic villi.

[*To face p.* 124.

it has been demonstrated that clusters of large 'decidual' cells may be found here and there in the mucous membrane of both the affected and the unaffected tubes. When the ovum lodges in the ampullary portion, the abdominal ostium almost invariably becomes occluded before the end of the second month (eighth week); when the ovum lies in the isthmus or the interstitial portion the abdominal ostium does not close (fig. 60). The condition of the ostium, as will appear later, has an important clinical bearing. A gravid tube is usually found, on opening the abdomen, to have contracted adhesions to surrounding structures; and at spots where the penetrating villi have reached, or nearly reached, the peritoneal coat, thick layers of lymph become deposited, the effect of which is to strengthen the weak spot.

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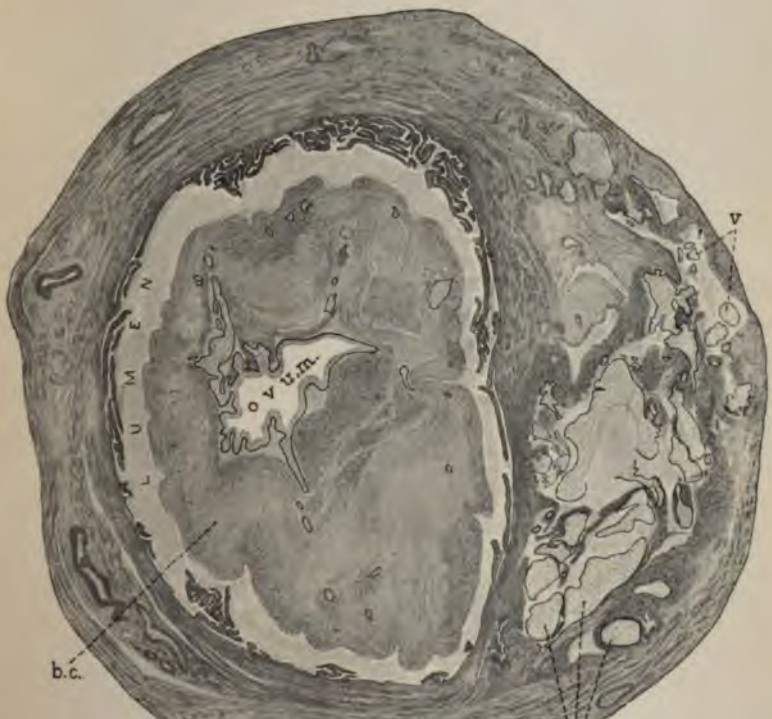

Fig. 61.—Early Tubal Pregnancy, showing Mode of Formation of a Tubal Mole, and Erosion of the Tube-wall by Villi.
(Whitridge Williams.)

b.c., blood-clot; v. chorionic villi.

[*To face p.* 124.

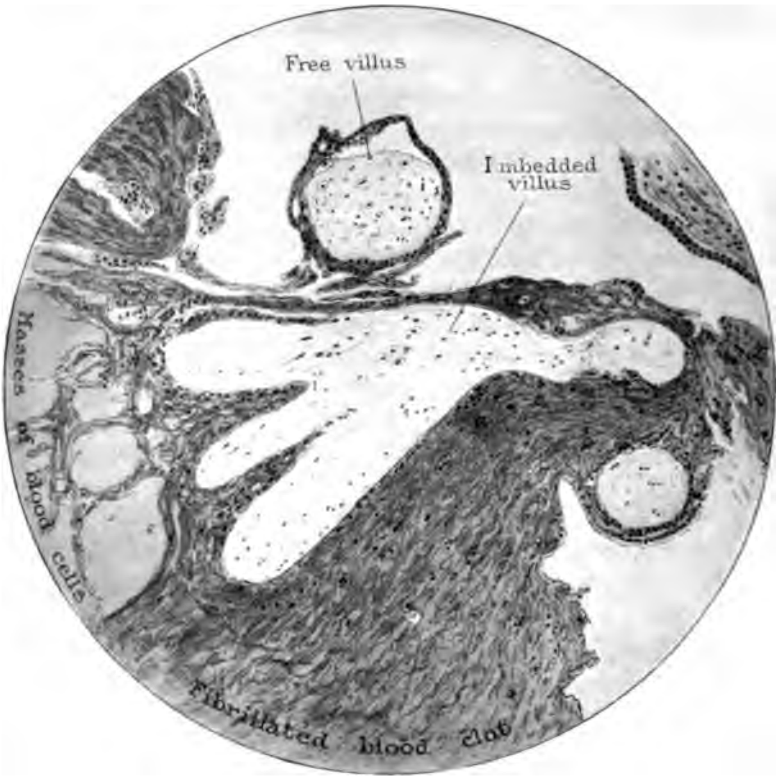

FIG. 64.—VILLI FROM A TUBAL MOLE.

The epithelium of the free villus shows little alteration, but the stroma is degenerated; the imbedded villus is practically structureless. Free syncytial buds are seen in the upper part of the figure.

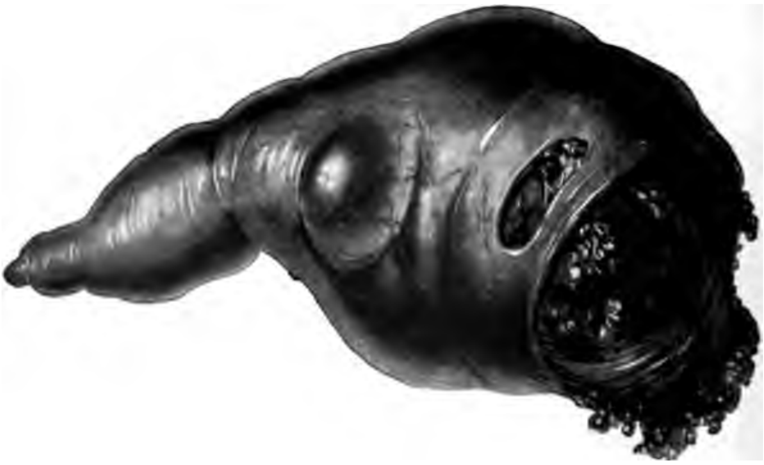

FIG. 65.—TUBAL ABORTION, OVUM BEING EXTRUDED THROUGH FIMBRIATED EXTREMITY. (KELLY.) × 1.

[*To face p.* 127.

the tube is narrower and less distensible than in the latter. Between the eighth and tenth weeks is the commonest time for rupture to occur, but it may be earlier or later than this. The conditions which predispose to rupture have been mentioned—viz. thinning of the tube-wall by distension, and the eroding action of the villi. In addition there is probably a determining cause in most instances, such as sudden increase in size of the ovum from hæmorrhage, or slight increase in vascular tension from some muscular effort on the part of the patient. Occasionally the eroding action of the villi alone will determine spontaneous perforation of the wall of the tube. Occlusion of the abdominal ostium is not an essential factor in the causation of rupture, which frequently occurs without it, even in the ampullary variety. Any part of the wall of the distended portion of the tube may burst.

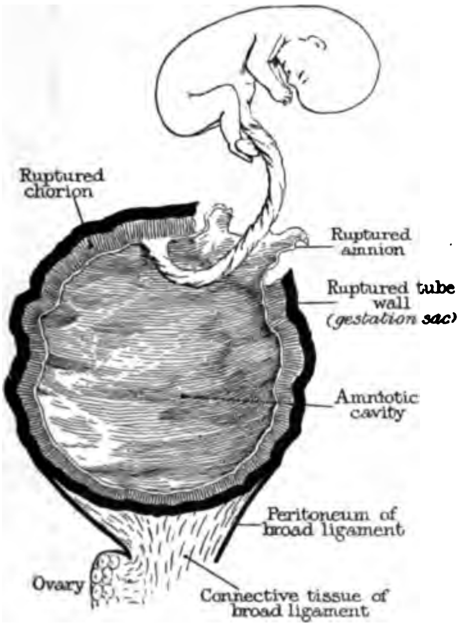
Ruptured chorion
Ruptured amnion
Ruptured tube wall (gestation sac)
Amniotic cavity
Peritoneum of broad ligament
Ovary
Connective tissue of broad ligament

FIG. 66*a*.—INTRA-PERITONEAL RUPTURE. (AFTER GILES.)

Rupture of the amnion. Placental portion of the chorion injured; the fœtus will perish.

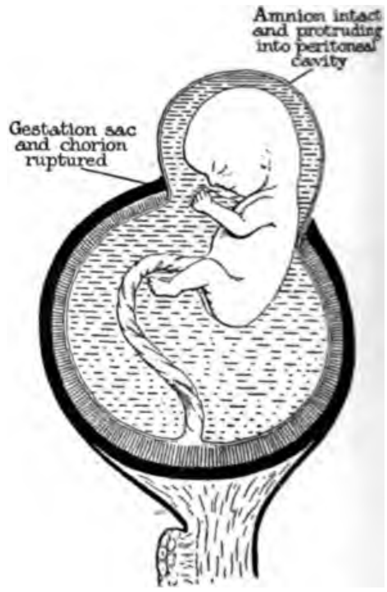
Amnion intact and protruding into peritoneal cavity
Gestation sac and chorion ruptured

FIG. 66*b*.—INTRA-PERITONEAL RUPTURE. (AFTER GILES.)

Amnion uninjured; the fœtus may survive. Placental chorion is at the opposite pole of the ovum.

The results of rupture, in so far as the life of the ovum is concerned, depend to a great extent upon the position of the rent. If occurring upon the roof or sides of the tube, the rupture will involve the peritoneal covering, and the blood effused will therefore be poured out into the general peritoneal cavity, while the ovum may or may not be seriously injured (fig. 66). If, on the other hand, the tear takes place in the floor of the tube, the peritoneal coat may escape, while the effused blood and the discharged ovum will make their way between the layers of the broad ligament, gradually separating them and burrowing in the connective tissue which this ligament contains (fig. 67). Large quantities of blood may in this way be effused into the broad ligament. This form of rupture is believed to occur mainly in cases of isthmial pregnancy, since this portion of the tube is less completely invested by peritoneum than the ampullary portion. The former is known as *intra-peritoneal* rupture, the latter as *intra-ligamentary* or *extra-peritoneal* rupture. In both varieties of rupture the ovum is as a rule destroyed by previous hæmorrhage. Apart from hæmorrhage, this result also

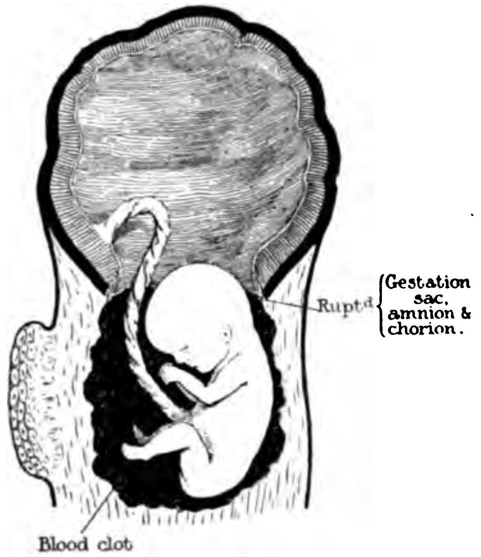

FIG. 67*a*.—INTRA-LIGAMENTARY RUPTURE. (AFTER GILES.)
Rupture of the amnion ; the fœtus will perish.

inevitably follows (*a*) if the amnion is ruptured, or (*b*) if the placental portion of the chorion is lacerated or detached by the rupture (figs. 66 and 67, *a* and *b*). Occasionally, however, the ovum may continue its development, and in such cases it is observed that the amnion has remained intact, and that the placental chorion was so situated as to escape injury from the rupture. In intra-peritoneal rupture the placenta then grows out of the rent and becomes attached to the neighbouring peritoneal surfaces, while layers of lymph are deposited upon the amnion from the surrounding peritoneum, forming a false membrane which constitutes a secondary gestation-sac. The ovum is now known as a *secondary abdominal pregnancy*. Precisely similar results may follow extra-peritoneal rupture, and for the same reasons; the ovum is then known as a *broad-ligament pregnancy*. Secondary abdominal pregnancy and broad-ligament pregnancy may both continue to term; the patient then usually passes through a 'false labour,' and the fœtus perishes. The

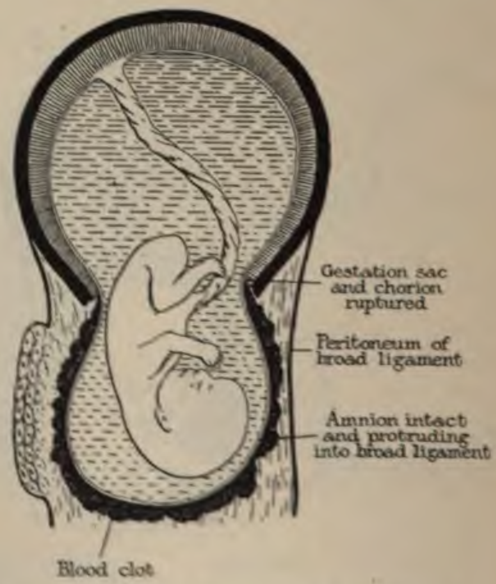
Gestation sac and chorion ruptured
Peritoneum of broad ligament
Amnion intact and protruding into broad ligament
Blood clot

FIG. 67*b*.—INTRA-LIGAMENTARY RUPTURE. (AFTER GILES.)

Amnion uninjured; the fœtus may survive.

occurrence of this false labour is a physiological point of great interest and importance, but we have no information as to its causation, or the mode in which it leads to the death of the fœtus. False labour is attended with severe abdominal pain, which is mistaken by the patient for labour, but there is no clinical evidence that uterine contractions play any part in its production. Broad-ligament pregnancy not infrequently undergoes secondary rupture into the peritoneal cavity; even then the ovum is not in all cases destroyed, but may continue as an abdominal pregnancy.

Many cases are on record, both in ancient and in modern times, in which an extra-uterine fœtus has been retained within the abdominal cavity for many years after its death. In some of these cases the gestation-sac has become infected from the bowel or the uterus, and suppuration has occurred, resulting in the formation of fistulous communications with the exterior, or with the neighbouring hollow viscera—large intestine, bladder, and vagina. Through these fistulæ fœtal bones are from time to time discharged. When, however, the sac remains free from infection the body of the fœtus shrinks by absorption of its fluid constituents, and upon the dried tissues lime-salts become freely deposited, converting it into a *lithopædion*. In this condition it may be retained for many years with little disturbance to the patient.

Clinical Features of Tubal Pregnancy.—The symptoms of tubal pregnancy must be considered at two stages: (1) before the occurrence of internal hæmorrhage; (2) after that occurrence.

(1) Before the course of gestation is interrupted or modified, tubal pregnancy gives rise as a rule to few, if any, symptoms, and these not of a serious character. Usually not more than one monthly period is missed, and not infrequently there is no cessation of menstruation at all, slight continuous or irregular bleeding following a normal period without any interruption of menstruation. The stage we are considering seldom extends beyond the tenth week, so that long periods of amenorrhœa cannot be expected. There may be morning sickness, and possibly a primigravida may complain of enlargement and tenderness of the breasts.

It appears probable, from clinical observation, that as long as the ovum remains unaffected its presence gives rise to very little inconvenience. Symptoms at once arise, however, when hæmorrhage, either limited to the ovum or escaping from the tube, occurs. Two symptoms then become apparent, viz. uterine hæmorrhage and pain. As Cullingworth has pointed out, the hæmorrhage from the uterus is usually steady, not irregular, moderate in amount, and dark in colour; it is due to partial separation of the decidual membrane by uterine contractions, excited by the changes occurring in the tube. The pain is colicky, often accompanied by nausea, and usually recurs in attacks of greater or less severity. The unruptured gravid tube forms an elastic, more or less globular, swelling, placed behind or to one or other side of the uterus; it may, however, occupy the utero-vesical pouch. Its nature can only be surmised from the accompanying symptoms.

(2) The symptoms which accompany internal bleeding in tubal pregnancy are extremely variable, and mainly depend upon the amount and the rapidity of the bleeding. If the hæmorrhage is rapid and the amount great, the effused blood becomes distributed in the peritoneal cavity, accumulating in the most dependent parts; this is called the *diffuse* type. If the hæmorrhage is slow and the amount small, the effused blood becomes quickly shut off from the general peritoneal cavity by the formation of lymph around it; this is the *encysted* type.

Diffuse Type.—Occasionally a single hæmorrhage occurs, so rapid and profuse as to cause the death of the patient in a few hours before surgical aid can be obtained. In such a case the hæmorrhage is always intra-peritoneal, and may be due either to rupture or tubal abortion. More frequently hæmorrhage is less severe, ceases spontaneously after a time, and, while imperilling the patient's life, is not necessarily fatal. It may, however, recur after an interval and prove ultimately fatal. The initial attack of bleeding may occur without any exciting cause, when the patient is at rest in bed, or even when asleep; more often it appears to have been induced by some slight muscular effort, such as that entailed by ordinary domestic work or by the act of defæcation. Severe abdominal pain, sudden in onset, situated in one or both iliac regions, is usually the first symptom. It is often accompanied by vomiting, and may lead to faintness or, less often, to actual loss of consciousness from syncope. Upon these symptoms supervene the signs and symptoms of shock or profuse hæmorrhage—pallor, rapid and feeble pulse, deep rapid breathing (air-hunger), coldness of the extremities or of the whole skin-surface of the body, perspiration, depression of temperature, and restlessness. Slight hæmorrhage from the uterus will also usually occur. At this stage the *diagnosis* cannot be carried beyond that of internal (abdominal) hæmorrhage; tubal pregnancy may be surmised from the history or from the presence of a pelvic swelling, but can only be confirmed by operation. Perforating appendicitis and perforation of a gastric ulcer have been frequently confounded with it. If the patient survives the immediate effects of the internal hæmorrhage, the condition comes to resemble the encysted type, and will pursue a similar course.

Encysted Type.—Acute symptoms, though often found, do not always mark the occurrence of the initial hæmorrhage in this type. The symptoms complained of are abdominal pain and vaginal bleeding, which may or may not ensue upon a brief period of amenorrhœa. After a few days an irregular rise of temperature usually, but not always, occurs with hypogastric pain, and the condition may be diagnosed as 'inflammation' or 'peritonitis.' In this type progressive internal bleeding occurs from a slight rupture or from a slow process of abortion, and around the effused blood, when intraperitoneal, inflammatory adhesions form, the effect of which is to isolate it from the general peritoneal cavity. The rise of temperature is due in part to this inflammatory reaction, and probably in part also to the effects of the absorption of fibrin-ferment by the peritoneum. The uterine hæmorrhage continues, and frequently the decidua is expelled, either entire and forming a complete cast, or in fragments; sometimes, however, no membrane is recognised in the uterine discharge, and it is therefore not certain that the decidua is always shed in bulk; it may be gradually cast off in the form of débris.

Diagnosis is easier in the encysted than in the diffuse type. Blood slowly poured into the peritoneal cavity from the gravid tube tends to accumulate in the pouch of Douglas, forming a *hæmatocele*—a swelling with fairly definite characters. When poured into the broad ligament the resulting swelling is often termed a ***hæmatoma***; it also possesses fairly definite characters.

Sometimes, in addition, a swelling in the region of the tube may be met with, which may be presumed to be the gestation-sac. Occasionally in tubal abortion, the effused blood, being slowly discharged from the tube, does not reach the pouch of Douglas, but accumulates around the abdominal ostium and quickly becomes limited by adhesions ; such an accumulation of blood around the mouth of the tube is called a *peri-tubal hæmatocele.* Occasionally the same result may follow intra-peritoneal rupture with slowly progressive hæmorrhage, a hæmatocele being formed in this case upon the roof or side of the tubes, around the site of the rupture; it is called a *paratubal hæmatocele.* To describe minutely the physical signs of these conditions would carry us out of the field of obstetrics as limited conventionally, and reference must be made upon these points to a text-book of gynæcology. It must not be overlooked, however, that an important step in diagnosis is the recognition of softening of the cervix, and a certain degree of softening with enlargement of the body of the uterus. In a primigravida signs of activity in the breasts are also important. These changes point to pregnancy, and if the uterus itself is not gravid, then the pregnancy must be extra-uterine.

Differential Diagnosis of Tubal Pregnancy.—Two conditions are especially liable to be confounded with tubal pregnancy—viz. (1) incomplete uterine abortion, and (2) retroversion of the gravid uterus. A number of other conditions may also undoubtedly be confused with it, but the results are not so serious as in the case of these two.

(1) *An incomplete uterine abortion* occurring during the second month and a tubal pregnancy resemble one another in the following particulars:

(*a*) History of a brief period of amenorrhœa.
(*b*) Signs of activity in the breasts (primigravidæ).
(*c*) Enlargement of the uterus and slight softening of the cervix.
(*d*) Irregular or continuous bleeding.
(*e*) Discharge of a membrane from the uterus.

From these points a diagnosis of incomplete uterine abortion may be made without local examination, and the patient consequently improperly or carelessly treated. Vaginal or bi-manual examination would, of course, reveal the fact that a pelvic swelling existed outside the uterus; but if the possibility of tubal pregnancy has been overlooked, the nature of this swelling may in turn be misunderstood, and it may be regarded as an inflammatory effusion on account of the accompanying fever.

(2) *Retroversion of the Gravid Uterus.*—A pelvic hæmatocele resulting from tubal pregnancy has been not infrequently mistaken for this condition, and the results of the mistake may be disastrous, for the hæmatocele may be ruptured into the general peritoneal cavity by manipulations intended to replace a supposed gravid uterus. A pelvic hæmatocele sometimes, though not invariably, causes retention of urine, and this condition, associated with signs of early pregnancy (amenorrhœa, softening of cervix, breast changes), at once gives rise to the suspicion of retroversion of the gravid uterus. On local examination, after evacuation of the bladder, in both conditions a large elastic swelling is found in the pouch of Douglas, thus increasing the resemblance between them. It is only by attention to the two following points that the diagnosis of hæmatocele can be made: (1) though the cervix may be displaced forwards and upwards, the anterior vaginal wall is not elongated; (2) the uterus lies entirely in front of the swelling felt in the pouch of Douglas; it is only slightly enlarged, but may be considerably elevated. An anæsthetic may be required to determine these points satisfactorily, as the use of the sound must, of course, be avoided while the diagnosis is in doubt.

Treatment of Tubal Pregnancy.—The treatment of this condition is essentially surgical, and the details of the operative measures which may be required belong to the domain of gynæcology, but the general principles upon which operative interference is based may be briefly indicated here.

There is a general consensus of opinion that an *unruptured gravid tube* should at once be removed by abdominal section in order to forestall the occurrence of rupture or abortion, with the grave risks to life which they involve; diagnosis is, however, very seldom made at this stage. The *diffuse* type of *internal hæmorrhage* from tubal rupture or abortion is in the majority of cases best treated by abdominal section and removal of the damaged tube, time being allowed, before operating, for recovery from shock to take place. Occasionally the condition of the patient may be too urgent to permit of any delay, and under these circumstances immediate operation must be performed, although the chance of saving the life of the patient is but small. In the *encysted* type treatment may be either palliative or radical. The former consists in prolonged rest in bed, so as to allow of absorption of the effused blood; this may be combined with vaginal drainage of the hæmatocele by posterior colpotomy. This line of treatment yields good results, but is very tedious and prolonged. Radical treatment by abdominal section and removal both of the effused blood and the damaged tube is followed by a much shorter convalescence, and is attended by only slight operative risk. *Abdominal* or *Broad-ligament pregnancy* has been treated in various ways, and no general agreement exists as to which is to be preferred. Probably the safest plan is to allow the gestation to continue until false labour supervenes and the fœtus dies; to wait several weeks in order that thrombosis of the placental sinuses may occur, and then to extirpate the entire sac, including the placenta, by abdominal section. Operation undertaken while the fœtus is alive is greatly complicated by the relations of the placenta, for the placental site may be spread over coils of intestine and other important viscera, and removal of this organ along with the fœtus leads to severe hæmorrhage, which is very difficult to control. In order to avoid this difficulty, some operators have left the placenta *in situ*, and allowed it to become gradually thrombosed, separated, and expelled piecemeal during convalescence through a sinus in the abdominal wall. This process is, however, attended with serious risks of sepsis. The method first mentioned appears to offer a comparatively safe middle course, but all operations for abdominal pregnancy are necessarily of serious prognosis.

Disorders associated with Pregnancy

Acute Infectious Fevers.—The mortality from these diseases is much higher among pregnant women than others, for the reason that abortion or premature labour ensues in about 50 per cent. of cases and detracts greatly from the patient's chances of recovery. Abortion appears to be brought about either by violent uterine contractions causing detachment of the ovum, or by the death of the fœtus, and is often preceded by severe hæmorrhage. The death of the fœtus may be due in some cases to the high temperature, in others to direct transmission of the disease, or to the passage of toxins into the fœtal circulation. Experiments have shown that pregnant animals can bear remarkably high temperatures without aborting, if the temperature is raised very gradually: clinically, however, it is found that in infectious fevers the risk of abortion is directly proportional to the height of the fever. Authorities differ as to the effect of *influenza* upon pregnancy, some regarding it as serious, others as unimportant.

Chronic Infections (Tubercle, Syphilis, and Gonorrhœa). *Phthisis* in women does not unfavourably affect fertility, nor does it unfavourably influence the course of pregnancy; usually the resulting children are well developed and show no sign of tuberculous disease when born. During pregnancy phthisical women often appear to improve in health, but most authorities believe that in the puerperium the tuberculous disease usually advances more rapidly. In a certain number of cases of acute miliary tuberculosis or advanced pulmonary phthisis, the transmission of tubercle bacilli from the mother to the fœtus has been demonstrated, but this occurrence is extremely rare. Only in quite exceptional circumstances does phthisis form an indication for the artificial termination of pregnancy.

Syphilis is the most frequent of all the constitutional causes of premature interruption of pregnancy. In the great majority of instances the source of infection is *paternal*; whatever may be the stage of the disease in the father, it is possible for the fœtus to be infected. The influence of *maternal* syphilis upon pregnancy varies according to the incidence of the disease. Women infected with syphilis before or at the time of conception miscarry in about three out of every four cases, the fœtus showing definite signs of the disease. In the cases of women infected subsequent to conception but early in pregnancy abortion often ensues, but with much less frequency. If the infection occurs late in pregnancy, the pregnancy may be uninfluenced and the fœtus born alive and healthy. Very rare cases probably occur in which a woman, impregnated by a man who, though syphilitic, displays no local infective lesion, contracts syphilis from the fœtus *in utero*. This is known as *conceptional* syphilis, and is characterised by complete absence of all lesions characteristic of the primary stage. Sometimes a syphilitic fœtus is born without any sign of the disease being recognisable in the mother, and even if she suckles her child she does not become obviously infected. This is known as Colles's law of immunity, but it is doubful whether the mother under these circumstances is not in reality affected by syphilis in an attenuated form; the fact that she does not become obviously infected from suckling her child appears to support this view. The signs of syphilis in the infant will be referred to later on (p. 474). Anti-syphilitic treatment of *both* parents is of course required in all cases where there is evidence of the existence of the disease in either, and even when the mother is apparently unaffected anti-syphilitic treatment must be steadily pursued throughout pregnancy in the interest of the child. A syphilitic infant should never be suckled by a wet-nurse.

Gonorrhœa.—When this disease is contracted during pregnancy it is apt to give rise to a very *acute* form of vulvo-vaginitis, associated with extensive redness and œdema of the skin-surfaces, and the formation of diphtheritic patches upon the mucous membranes. The presence of *chronic* gonorrhœal infection of the vagina and cervix is not necessarily a hindrance to conception, and most of the cases of gonorrhœa met with in pregnancy are of this nature. Vulvo-vaginitis of gonorrhœal origin, whether acute or chronic, has little effect upon the course of pregnancy. Abortion is not very frequent, and it is probably quite exceptional for the uterine cavity to be invaded by the organism during pregnancy. The disease may, however, ascend to the cervical mucous membrane and thence to the decidua, causing *acute* decidual endometritis (see p. 111), a condition which invariably leads to abortion. In all cases there is the risk that the disease may spread to the Fallopian tubes, ovaries, and pelvic peritoneum in the puerperium, with the most serious or even fatal consequences. During labour, gonorrhœal vaginitis, whether acute or chronic, entails serious risks of infection of the eyes or mouth of the fœtus. Gonorrhœal discharges at all stages of pregnancy accordingly require careful local treatment by vaginal douching and other measures, the details of which are described in text-books of gynæcology. It must also be remembered that gonorrhœal discharges are infectious at all stages, and even when the specific organism has disappeared other pathogenic bacteria may be present; the greatest care must therefore be taken to prevent the transmission of the infection to other patients.

Diseases of the Heart and Circulatory System.—*Chronic valvular disease* of the heart is not infrequently met with in pregnant women. In about 70 per cent. of such cases the mitral valve is the one affected, mitral insufficiency, either alone or combined with stenosis, being much commoner than simple stenosis, which is but rarely met with in pregnancy. Lesions of both the aortic and the mitral valves may also be met with, but simple aortic lesions are rare in women. The most serious cases are those in which mitral stenosis is present, either alone or in company with other lesions.

The clinical importance of mitral lesions in connection with pregnancy and labour is a subject upon which opinions are divided. Some authorities consider that the risk of pregnancy in such cases is so great that women suffering from these lesions should be forbidden to marry, and if married should be advised to avoid the occurrence of pregnancy. It is probable that these authorities have taken an exaggerated view of the gravity of this condition. French and Hicks have recently analysed the obstetric history of three hundred consecutive cases of women with mitral lesions treated at Guy's Hospital. They found that the average number of children borne by these women was 4·5, one woman passing successfully through seventeen pregnancies. In only 8 per cent. of these cases did failure of compensation occur in the first pregnancy; and among those who passed through five pregnancies, the proportion of cases of failure of compensation was only 15 per cent. It is obvious from these figures, and from numerous observations of small numbers of cases, that mitral disease does not form such a serious complication of pregnancy as was formerly supposed, and prohibition of marriage or pregnancy in such cases cannot be justifiable as routine practice.

As long as compensation is maintained a woman suffering from mitral lesions may pass successfully through a number of pregnancies without running any serious risk. Irregular hæmorrhage during the early months is not uncommon, and there is a marked tendency to the occurrence of abortion or premature labour. But when compensation breaks down, either as the result of pregnancy, or from other causes, such as recurrence of rheumatic fever, the patient's condition immediately becomes one of great gravity. When due to pregnancy this is most likely to occur in the later months, or during labour; it may, however, come on in the early months of pregnancy, or in rare instances in the early days of the puerperium, when rapid dilatation of the right heart, leading to a fatal result, may ensue. The treatment of failure of compensation during pregnancy follows the usual lines adopted in this condition; if general medical measures fail to alleviate the condition, abortion or premature labour must be induced. These events, however, often occur spontaneously when compensation breaks down.

The greatest care must therefore be taken to maintain compensation during pregnancy and avoid over-strain; so long as this is successful, pregnancy may be allowed to continue. If, however, a patient who has had the good fortune to survive a previous failure of compensation during pregnancy or labour should again become pregnant, abortion should be at once induced.

Varices in the lower extremities and labia majora are apt to become greatly aggravated by pregnancy, giving rise to pain and inability to walk. Vulval varices sometimes rupture from traumatism, with profuse hæmorrhage, which has been known to prove fatal in the absence of proper surgical aid.

Renal Diseases.—The influence of *chronic nephritis* upon pregnancy has already been referred to when considering the subject of albuminuria. To distinguish between this condition and the transient renal changes characteristic of the 'pregnancy kidney' may be somewhat difficult, when the existence of chronic nephritis has been unsuspected before conception. In the following points chronic nephritis with pregnancy will be found to differ from the albuminuria of pregnancy:

(1) Albuminuria and œdema appear much earlier (see p. 78).

(2) Œdema is likely to affect the face and upper extremities.

(3) Characteristic changes may be found in the arteries, the heart, and the retina (exudative retinitis may, however occur in the albuminuria of pregnancy).

(4) Intercurrent attacks of acute nephritis may ensue.

(5) Epithelial casts may be found in the urine.

In general terms it may be said that, on the one hand the effect of pregnancy usually is to aggravate the renal disease; on the other, the disease usually causes the pregnancy to terminate prematurely, tends to destroy the fœtus by inducing placental degeneration, and may cause the death of the mother from uræmia. Convulsions which ensue under these circumstances must be regarded as mainly uræmic in origin. The fœtal mortality in chronic nephritis is very high indeed.

From these considerations it will be apparent that pregnancy in the subjects of chronic nephritis involves grave risks. A patient who has survived an attack of uræmia in a previous pregnancy should not be allowed to incur the risks again; and if conception does take place, abortion should be induced without delay. In the case of a primigravida, or if previous pregnancy has not been attended with serious complications, palliative treatment may be adopted and a careful watch kept upon the condition of the urine; but the chances of the patient bearing a living child are by no means good. The occurrence of an intercurrent acute attack of nephritis almost always ends in abortion.

Pyelitis.—Considerable attention has been paid of late to the occurrence of pyelitis during pregnancy, and certain facts have been established with regard to it. From the analysis of a series of recorded cases it has been shown that this condition occurs in the second half of pregnancy, that it is attended usually by an acute onset, is relatively more frequent in primigravidæ than in multiparæ, and is practically confined to the right kidney. It is characterised by pain in the right loin, fever, and pus in the urine, without any of the characteristic symptoms of cystitis. Pure cultures of colon bacillus have been found in a number of cases submitted to bacteriological examination. It therefore appears to be due to two factors: (*a*) pressure upon the right ureter by the gravid uterus; (*b*) infection with the colon bacillus. The normal right obliquity of the uterus accounts for the great predominance of cases affecting only the right kidney. The general tendency of the condition is to recover spontaneously without active treatment; sometimes it disappears before labour; if it persists to term, rapid cure usually follows evacuation of the uterus. In a certain number of severe cases it has been found necessary to induce labour.

Diseases of the Liver.—Pregnancy is, in some unexplained manner, one of the predisposing causes of *acute yellow atrophy* of the liver. This rare disease induces changes in the organ similar to those often found in fatal cases of puerperal eclampsia. Jaundice in pregnant women is always a somewhat serious symptom, owing to the fact that it may indicate the onset of acute yellow atrophy. No treatment is known which will arrest the course of this malady.

Diabetes is seldom found in association with pregnancy, probably because it exerts an influence unfavourable to conception. The frequent occurrence of traces of lactose in the urine of healthy pregnant and nursing women must be recollected, and due care exercised before arriving at a diagnosis of diabetes. Pregnancy seldom goes to term, and in nearly 25 per cent. of recorded cases the mother has died of diabetic coma. Hydramnios is said to be frequently associated with diabetes, the amniotic fluid containing sugar.

Diseases of the Nervous System.—*Neuritis* supposed to be of toxæmic origin sometimes occurs during pregnancy; it may affect a single nerve or may be multiple. Severe pain, limited to the distribution of the affected nerve, is the prominent symptom. It disappears rapidly after labour.

Chorea is not infrequently met with during pregnancy. In about two-thirds of the cases there is a previous history of chorea, and often of chorea and rheumatism combined. It is rather more common in the first than in a subsequent pregnancy. Spontaneous abortion occurs in from 10 to 15 per cent. of cases, and the mortality of the disease is variously estimated at from 5 per cent. to 40 per cent.; the latter figure is probably much too high. The usual treatment consists in complete rest in bed and liberal diet, the administration of chloral hydrate to produce sleep, and various antirheumatic remedies. Attempts have recently been made to show that the disease is toxæmic in origin, and should be treated by rest, milk diet, and stimulation of the functions of elimination. In some cases the movements are very severe and continuous, fever appears, and the patient becomes greatly exhausted; abortion must then be induced.

Herpes gestationis.—This rare affection is believed to be a neuritis of toxæmic origin. It is characterised by multiform skin lesions, the commonest type being crops of papules, vesicles, or pustules of herpetiform character; they are distributed chiefly upon the buttocks, the flanks, the forearms, and the back of the thighs. Sometimes the disease affects the skin of the whole body, is very intractable, and may cause serious exhaustion from uncontrollable irritation and want of sleep.

Ovarian Tumours.—The presence of a unilateral ovarian cyst, if uncomplicated, forms no hindrance to conception; bilateral solid tumours, whether benign or malignant, are practically never found in association with pregnancy. Single cysts of moderate size, which rise into the abdominal cavity along with the uterus as it develops, give rise to no symptoms and are often not discovered until labour sets in; or even until, during the puerperium, the size of the abdomen draws attention to their presence. Small tumours which during pregnancy remain in the pouch of Douglas are subjected to considerable pressure, and may give rise to pain and interference with the functions of the bladder and rectum. They may obstruct labour (see p. 311), and they not infrequently give rise to serious trouble during the puerperium, from axial rotation of the pedicle or from injury received in labour. As a rule, ovarian tumours discovered during pregnancy should be at once removed; ovariotomy in pregnant women is no more serious than in the non-pregnant, but abortion follows in about 20 per cent. of cases.

Tumours of the Gravid Uterus.—I. **Fibroids and Pregnancy.**—Conception does not readily occur in a uterus which is the seat of a fibroid tumour when that tumour is submucous or interstitial in position, whether it is small or large. Subperitoneal fibroids, however, are probably no hindrance to conception, whatever their size may be. And although the first-named varieties are a hindrance to conception they by no means absolutely prevent it, so that the association of fibroids with pregnancy is not uncommonly met with.

The Diagnosis of Pregnancy in a uterus enlarged and distorted by the presence of one or more fibroid tumours may present great difficulties. The degree of difficulty will depend in the main upon the position of the uterine cavity and its relation to the tumour or tumours. Sometimes the cavity is anterior and accessible to abdominal palpation, when diagnosis will be comparatively easy; but it may lie behind the tumour which intervenes between it and the abdominal wall; or, as in fig. 68, it may be placed between two tumours, when diagnosis will be very difficult. Until the presence of the fœtus can be directly detected by palpation or by auscultation of the heart, the diagnosis of pregnancy can only be presumptive. During the first five months the greatest importance must be attached to amenorrhœa; sudden cessation of the menses in a patient with a fibroid tumour almost invariably implies pregnancy, unless the age of the menopause has been reached. But sometimes irregular hæmorrhage takes the place of amenorrhœa, and this change is not so important, as it frequently occurs in connection with fibroids from other causes. Signs of activity in the breasts carry, perhaps, less

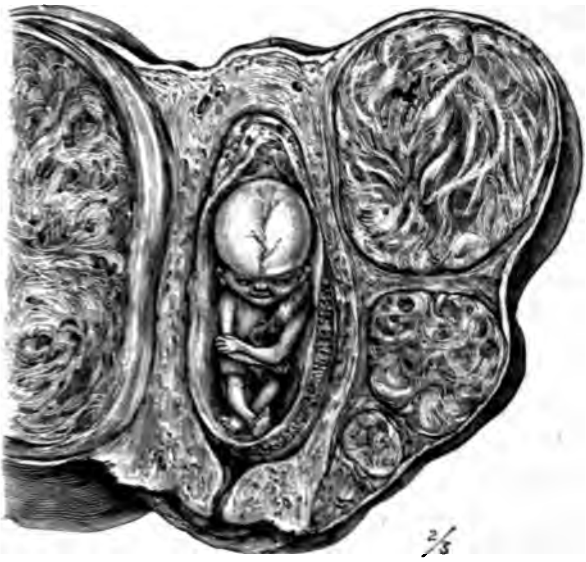

FIG. 68.—PREGNANCY WITH MULTIPLE FIBROID TUMOURS OF THE UTERUS. (BLAND-SUTTON.)

than their usual importance in these cases, because secretion is sometimes found in the breasts of nulliparous, non-pregnant women who are the subjects of uterine fibroids. Pregnancy causes rapid enlargement, with softening of the uterus and, to a less extent, of the tumours which it contains. Owing to the distortion caused by the new-growths, the alterations in shape characteristic of the early months of pregnancy cannot be made out, while softening of the cervix is usually late in appearing. A uterine souffle can often be heard over some part of a non-gravid fibroid uterus, so that the presence of this sign also is unimportant. It will thus be readily seen that diagnosis must be difficult at this stage of pregnancy; repeated examinations will be required, and even then it may be necessary to postpone diagnosis until the period at which the fœtal heart can be heard.

During the later months the gravid part of the uterus may be found to occupy almost any position with regard to the tumour; usually it is placed more or less laterally, but may be in the upper or lower portions of the mass. Upon its position will depend the degree of ease with which the fœtal heart or limbs can be detected.

Clinical Course.—Pregnancy certainly causes recognisable softening of fibroid tumours, but opinions differ as to whether it causes their rate of growth to increase, and the truth is not easy to establish. Upon the general course of pregnancy and the development of the fœtus, fibroids exert no unfavourable influence, unless some complication should arise. A fibroid tumour impacted in the pelvis may cause severe pressure-symptoms as the uterus develops, but these effects are due to the accident of its position. Axial rotation of a stalked subperitoneal fibroid may occur, though very rarely, during pregnancy; and previously existing adhesions may become troublesome through being stretched. But in the majority of cases the course of pregnancy is attended by very little more discomfort than may be met with when there are no fibroids present. There is, however, undoubtedly a somewhat greater risk of pregnancy ending prematurely either in abortion or premature labour. The effect of fibroids upon labour will be considered in a later section (p. 314).

Management.—Pregnancy should be allowed to continue until term, unless (1) severe complications due to the tumour arise, or (2) the tumour is so situated as inevitably to cause insuperable obstruction during labour. In the former case the offending tumour should, if possible, be removed by myomectomy and the uterus allowed to remain; this operation is followed by spontaneous abortion in about 50 per cent. of cases. In the latter case there are two possible alternatives: (*a*) abortion may be at once induced; (*b*) the pregnancy may be allowed to continue until term, and the child then delivered by Cæsarean section, the uterus being at the same time removed. The induction of abortion cannot be recommended; the position of the fibroid tumour necessarily renders dilatation of the cervix difficult, and if interference is necessitated to evacuate the uterus, serious mechanical obstacles may have to be overcome. Cæsarean hysterectomy (see p. 524) at or near term is no more serious than hysterectomy at an earlier period when the fœtus is non-viable, and is therefore on the whole the best method of dealing with such cases.

II. **Malignant Uterine Disease and Pregnancy.**—Pregnancy is unknown in connection with carcinoma of the body of the uterus; it may, however, be found in association with sarcoma, and there is reason to believe that in some cases of chorionepithelioma (deciduoma malignum) this growth has commenced during pregnancy. Cancer of the cervix and pregnancy are not infrequently associated (fig. 71), and the diagnosis does not present the same difficulties as in the case of uterine fibroids and pregnancy; for, the body of the uterus being unaffected by the disease, the characteristic changes in it can be recognised at any period of pregnancy. Amenorrhœa may be obscured by irregular hæmorrhage from the growth, and of course the condition of the cervix prohibits the characteristic softening of pregnancy from taking place.

Management.—When the cervical carcinoma is in the *operable* stage the presence of pregnancy should be ignored, and the whole uterus removed with the disease. The method of operating will depend upon the size of the uterus—*i.e.* the stage of pregnancy; if the child is viable (after twenty-eighth week) it can be first delivered by Cæsarean section; if non-viable (earlier than twenty-eighth week) the uterus can be removed by vaginal hysterectomy, the organ being opened and its contents evacuated during the operation. When the disease is *inoperable* abortion may be induced in the early months; but after the mid-term of pregnancy in such cases it is probably better to wait, and then deliver the child by Cæsarean section at term.

Abortion: Miscarriage

Abortion is the expulsion of the ovum from the uterus at a period before the fœtus has become viable; the term *viable* signifying that the fœtus is capable of maintaining its existence when born. Until the middle of the seventh calendar month (twenty-eighth week) the fœtus is non-viable, therefore pregnancy terminating before this date is said to terminate by abortion. The term *miscarriage* is best employed as a synonym of abortion; sometimes, however, the latter is used only during the first two to two and a-half months, when the ovum possesses no properly developed placenta, while the former is applied to all stages of the non-viable period later than this. Such a distinction is confusing and has nothing to commend it, because the process is scarcely affected by the presence or absence of the placenta. Abortion is a miniature labour consisting of a stage of dilatation, a stage of expulsion, and a stage of retraction. It may occur spontaneously or be intentionally induced; the former alone will be considered here, the latter being dealt with among the Obstetric Operations.

Causation.—The causes of abortion are very numerous; they will be best considered in three groups: (1) *pathological conditions* of the mother and of the ovum (including the fœtus); (2) *traumatic causes*; (3) *general or systemic causes.*

(1) The *pathological conditions,* maternal and fœtal, which may cause abortion have been already tabulated (see p. 74) and the more important ones fully considered as disorders of, or associated with, pregnancy, and need not be again set out. Of these conditions, some are very apt to cause abortion, others rarely cause it; and from what has been said of each, no difficulty will be experienced in distinguishing between those which are important in this respect and those which are not.

(2) Of the traumatic causes the most important is *injury to the uterus or the uterine contents.* This may occur in

a variety of ways, as from direct violence, such as blows or kicks on the abdomen, or from severe falls or other accidents. Sometimes the uterus is actually ruptured by a blow on the abdomen; both blows and falls, however, usually operate, not by injuring the uterus, but by causing detachment of some part of the ovum from the uterine wall. The inadvertent passing of the sound or other instrument into the gravid uterus, leading to rupture or detachment of the ovum, may induce abortion; but sometimes the ovum escapes injury, and then no harm results from this accident if the instrumentation was aseptic. Operations upon the gravid uterus or the uterine appendages are frequently, though by no means invariably, followed by abortion, which in this case probably results from disturbance of the uterine or pelvic circulation. These causes of abortion rarely produce that effect immediately, an interval of several days, or even a week or two, elapsing before abortion sets in.

Next in importance to direct or indirect injury must be placed a group of conditions which cause abortion by *exciting the uterine centre* situated in the lumbar enlargement of the spinal cord (see p. 193), the stimulus being conveyed through the central nervous system. Extreme degrees of grief or fright, as from sudden bereavement or personal danger, may cause abortion, especially in women of nervous temperament; and it is clear that such conditions can only operate in the manner just indicated. Over-fatigue, especially from dancing and riding, probably acts in the same way. Operations upon distant parts performed during pregnancy also sometimes induce abortion, which must clearly be produced through the central nervous system. These conditions, all of which involve 'shock' to important nerve-centres, may be justly classed as traumatic.

Many drugs have from time to time been employed for the illicit production of abortion (abortifacients), but no scientific study of their mode of action has ever been made. The greater number of them are irritant poisons.

(3) The *general or systemic causes* consist of a number of conditions, the action of which in causing abortion is imperfectly understood. Thus consanguinity of the parents, high altitude, and hot climate are all believed to cause it. Unhealthy occupations pursued by the mother alone or by

both parents, such as working with lead, mercury, or glass, undoubtedly also cause abortion. Habitual over-indulgence in alcohol and excessive sexual intercourse are said to favour its occurrence. A paternal syphilitic taint is one of the most frequent systemic causes of abortion; usually no definite sign of disease is found in the ovum in such cases.

It must be added that the cause of abortion in a particular case is often very difficult to trace; and in exceptional cases an apparently healthy patient may have a series of abortions for which no adequate explanation can be discovered.

Frequency.—It will be clear from this enumeration of the conditions which cause it that abortion is not an uncommon event. From some recent statistics presented by Professor Malins to the Obstetrical Society of London it appears that in this country about 16 per cent. of pregnancies terminate by abortion—*i.e.* one abortion occurs to every five births of viable children; and further it appears that abortion is nearly twice as frequent among the classes from which hospital patients are drawn as among the well-to-do. Presented in another way, it may be said that from 30 per cent. to 40 per cent. of all fertile women pass through one or more abortions during the period of child-bearing. Far more abortions occur in the third month of pregnancy than in any other. Women who are the subjects of syphilis or Bright's disease often sustain a succession of abortions without carrying any pregnancy to term.

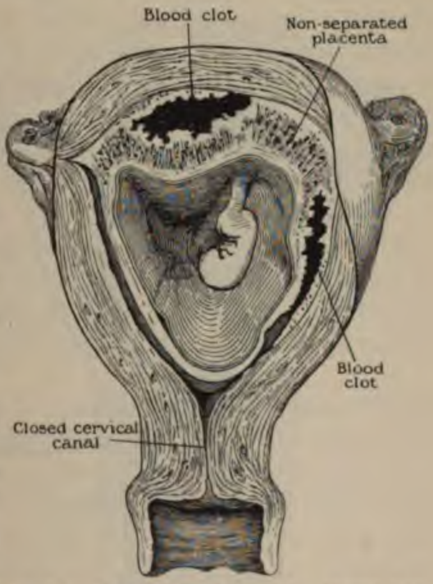

FIG. 69.—ABORTION: STAGE I. OVUM PARTIALLY DETACHED, CERVIX CLOSED. (EDGAR.)

Clinical Features.—The symptoms which accompany the process of abortion are *hæmorrhage* and *pain*. Hæmorrhage after the internal os has been already fully dilated; this offers some difficulties in diagnosis, for the condition of the cervix within the external os cannot well be recognised.

When the cervical canal is sufficiently dilated, the ovum is expelled through it by the uterine contractions, either entire or in pieces; an early ovum discharged in pieces may escape notice unless all the blood and blood-clot passed by the patient is carefully examined. When the whole ovum, including the decidua, has been expelled, the pain ceases and the hæmorrhage abates; for several days, however, a hæmorrhagic discharge occurs, similar to the lochial discharge of the puerperium, and the uterus itself undergoes a process of involution similar to puerperal involution, and occupying about the same time for its completion. If a portion of the ovum or decidua remains unexpelled from the uterus, the hæmorrhage will continue until it has been got rid of.

A number of terms are in common use in this country which are intended to describe certain clinical varieties or phases of the process of abortion; thus we speak of *threatened* abortion, *inevitable* abortion, *incomplete* abortion, and *missed* abortion.

Threatened Abortion.—Sometimes pain and hæmorrhage occur during early pregnancy without leading to dilatation of the cervix. Caution must be exercised in attributing these symptoms in all cases to abortion, for they may result from a number of other causes—*e.g.* the bleeding may not come from the body of the uterus at all, but from some concurrent disease of the cervix, such as a polypus or a malignant growth. And when the bleeding can be clearly traced to the uterine cavity, abortion by no means always ensues: it is certain that a good deal of hæmorrhage may occur in early pregnancy without causing detachment of the ovum. For example, hæmorrhage may occur from the undetached decidua in decidual endometritis, or in connection with cardiac or hepatic disease of the mother. It is even possible that slight detachment of some part of the ovum or the decidua itself may be repaired and the gestation allowed to continue. In fig. 71 it is seen that considerable hæmorrhage has occurred into the decidual space without separation of the ovum, which is intact, though somewhat compressed. Clinically, the bleeding in this case was attributed to the coincident malignant disease of the cervix. Whatever may be the explanation, it is certain from clinical experience that one or more smart haemorrhages in early pregnancy, or slight bleeding continued for several weeks, is not incompatible with the completion of gestation and the birth of a healthy child. Pain and hæmor-

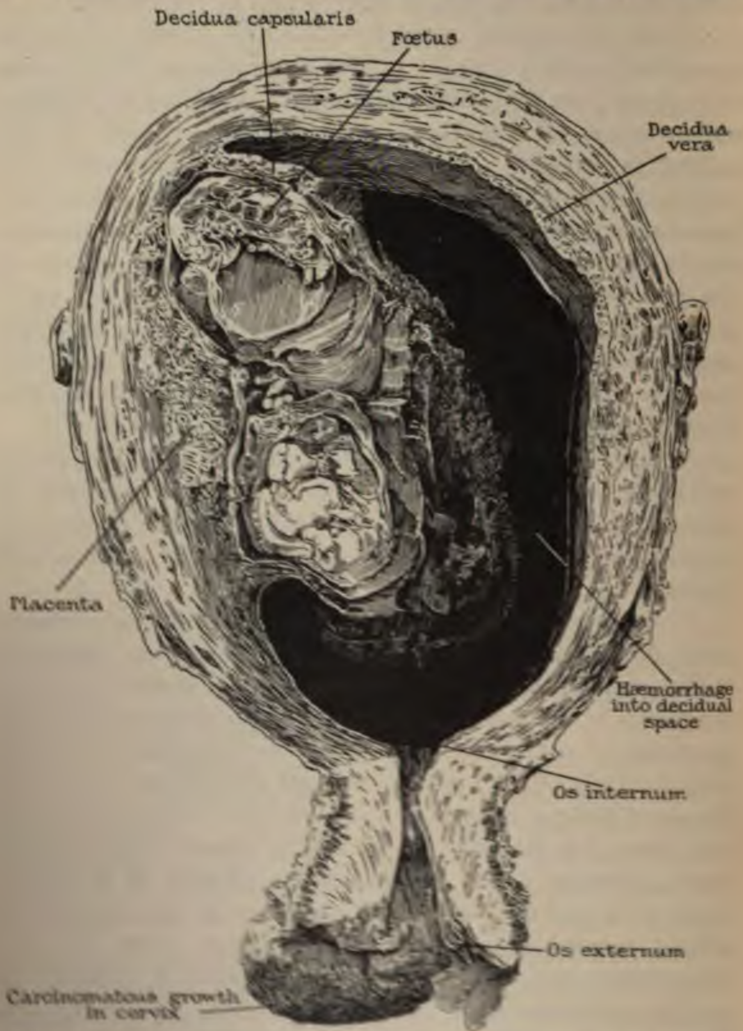

FIG. 71.—GRAVID UTERUS (FOURTH MONTH), SHOWING EXTENSIVE DECIDUAL HÆMORRHAGE WITHOUT DETACHMENT OF THE OVUM. (CHARING CROSS HOSPITAL MUSEUM.)

The uterus was removed for carcinoma of the cervix.

rhage must therefore never be regarded as certain indications of abortion unless they are accompanied by dilatation of the internal os, or the expulsion of some part of the ovum (fœtal or maternal); when unaccompanied by these changes it is convenient to refer to the condition as *threatened abortion*. By suitable treatment the process can often be arrested here and the danger averted. It is not uncommon, however, for symptoms of threatened abortion to subside, and after an interval to recur with greater severity. The condition must, however, always be regarded seriously, for alarming and even fatal hæmorrhage may occur from separation of an early ovum without any attempt being made by the uterus to evacuate its contents spontaneously. Such cases, being unattended by dilatation of the cervix, are technically cases of threatened abortion.

Inevitable Abortion.—When the pains are regular and intermittent, when the internal os commences to open, when the ovum has been detached and can be felt in the cervix, or when some portion of the decidua has been expelled, the process of abortion cannot be arrested, and is therefore said to be *inevitable*. The distinction between threatened and inevitable abortion is an important practical point, for the two phases must be differently treated.

Incomplete Abortion.—This name implies that some portion of the placenta or of the decidua has been retained in the uterus; the condition is also often termed 'retention of products of conception.' Continuance of bleeding, with absence of the expected involution of the uterus, are the chief symptoms; to these may be added those of septic infection, if the cavity of the uterus has not been kept sterile.

Missed Abortion.—This term has already been explained when describing the fleshy or carneous mole (p. 106). Symptoms of threatened abortion occur, which subside, and after a variable period a mole is expelled.

Anatomy of Abortion.—The condition of the ovum when expelled depends partly upon its period of gestation, and partly upon the changes which it has previously undergone. The great majority of aborted ova show no recognisable morbid change; they were apparently healthy up to the time of their expulsion. Others show various stages of the blood-mole previously described, or of the hydatidiform mole, these, of course, being ova of the first three months of gestation. Older ova which possess a definite placenta, when retained for some weeks after the death of the fœtus, show well-defined post-mortem changes, including those already described as placental infarcts.

Ova apparently healthy may be expelled entire—with or without the maternal coverings—or piecemeal. During the first and second months the ovum, when thrown off, may carry with it all the decidual coverings, the whole contents of the uterus being thus evacuated *en bloc.* More frequently the decidua capsularis is ruptured, and the ovum (chorion, amnion, and fœtus) escapes and is expelled entire through the cervix (figs. 72 and 73). The attachments of the chorion to the decidua are so delicate at this period that the force of the uterine contractions alone severs them completely. After the second month the chorion as well as the decidua is usually ruptured (fig. 74); the amnion, being more elastic, usually resists, but it also may be ruptured, and then the fœtus escapes and may be lost in the discharged blood. Often the chorion and decidua are so firmly attached to one another and to the uterus that a portion of chorion remains, making the abortion incomplete; this is more apt to occur with the placental chorion than with the chorion læve.

The period of gestation to which the ovum belongs may be estimated from the size and characters of the fœtus, or from the size of the chorionic sac when entire. The size and characters of the fœtus at different periods of development have been stated on page 34; they form the best guide to the period of development of the ovum. When the fœtus has been lost other criteria must be relied upon. The size of the unruptured chorionic sac is the next best guide; during the first three months it is as follows:

1st week	(Peters's ovum) .	about	$\frac{1}{10} \times \frac{1}{20}$ of an inch	(2·5 × 1·2 mm.)
2nd „	(Graf Spee's ovum)	„	$\frac{1}{4} \times \frac{1}{5}$ „	(6 × 5 mm.)
4th „	. . . .	„	$1 \times \frac{3}{4}$ „	(2·5 × 2 cm.)
8th „	. . . .	„	$2 \times 1\frac{3}{4}$ inches	(5 × 4 cm.)
12th „	. . . .	„	$4\frac{1}{2} \times 4\frac{1}{2}$ „	(11½ × 11½ cm.)

Up to the eighth or ninth week the whole chorion is covered with villi (fig. 15); then those of the chorion læve atrophy, and by the end of the third month the discoidal placenta has been definitely outlined. It seldom happens that a fœtus of

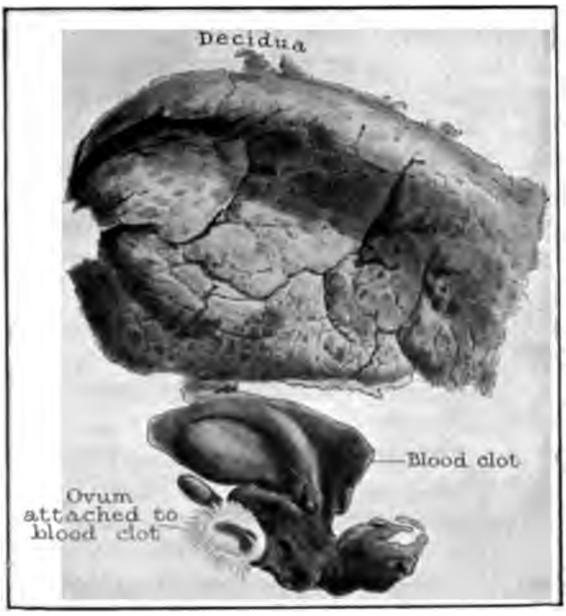

FIG. 72.—TWO TO THREE WEEKS' ABORTION.

(CHARING CROSS HOSPITAL MUSEUM.)

The ovum, covered with villi, has escaped from its decidual coverings and is attached to a piece of blood-clot.

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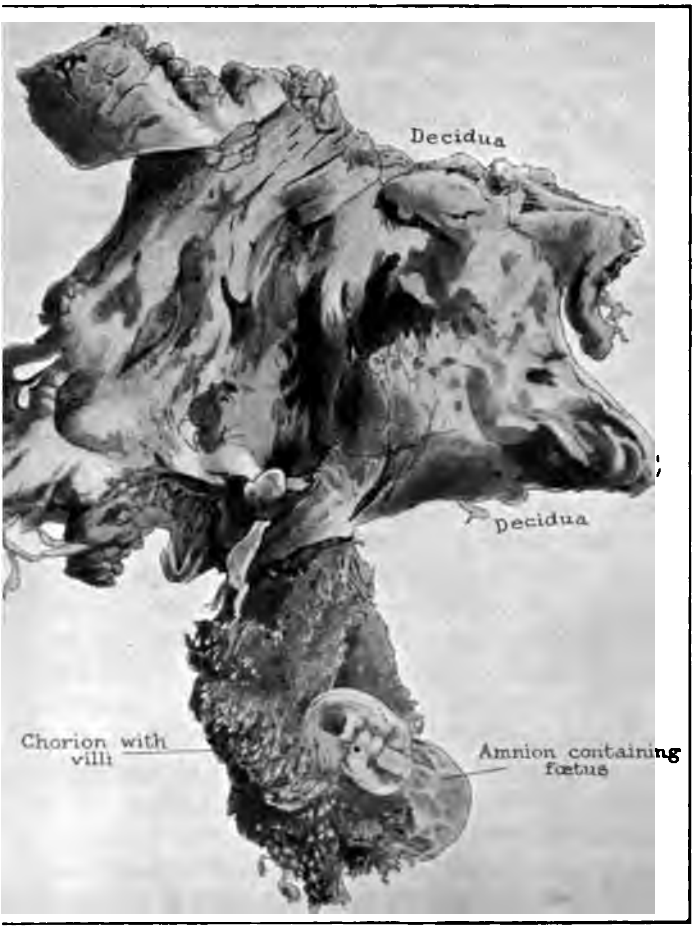

3.—Six Weeks' Abortion. (Charing Cross Hospital Museum.)

um has escaped from the decidua capsularis, but retains a small decidual attachment. The chorion is ruptured, the amnion is entire.

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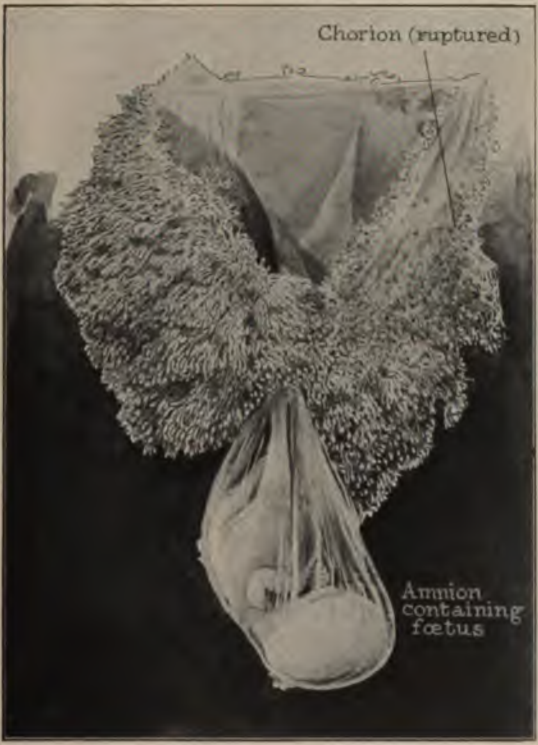

Fig. 74.—Two to Three Months' Abortion.
(Charing Cross Hospital Museum.)

[*To face p.* 154.

the size of three months' development escapes recognition in a miscarriage.

Differential Diagnosis.—Two other conditions resemble abortion, inasmuch as they are characterised by the expulsion of a body from the uterus with hæmorrhage and pain; they are (1) *tubal gestation* and (2) an *intra-uterine polypus.*

(1) The former has already been referred to (p. 134). It has been pointed out that the structure of the decidual membrane is identical in both uterine and extra-uterine pregnancy, and therefore uterine abortion cannot be diagnosed unless structures recognisable as chorionic or fœtal have been expelled from the uterus. (2) An intra-uterine polypus sometimes protrudes through the cervix, either with or without complete detachment. Hæmorrhage, pain, enlargement of the uterus, dilatation of the internal os, and the presence of a soft bulging swelling in the cervical canal may appear to justify a diagnosis of inevitable abortion. But further inquiry and examination will serve to distinguish the two, for with a polypus there will be a history of hæmorrhage, not amenorrhœa, and the customary signs and symptoms of pregnancy will be absent.

Treatment

Prophylaxis.—Prophylactic treatment is naturally of great importance. Many of the conditions described as systemic causes of abortion are capable of being cured by appropriate treatment, thus removing the cause of previous abortions. Syphilis is perhaps the most important of these, and the necessity of treating both parents in such cases has been already mentioned. Careful management of pregnancy in the early months may obviate certain of the traumatic causes; and it is a popular belief, which is supported to some extent by clinical experience, that the menstrual epochs are times of greater danger, when unusual precautions are required. In cases of decidual endometritis and of repeated abortion for which no systemic or local cause can be found, curettage of the uterus is useful. If the least suspicion of syphilitic taint exists in such cases, specific treatment should of course be fully carried out.

In threatened abortion the object of treatment is to arrest the process; in inevitable abortion the object is to asssit it.

Threatened abortion is accordingly treated by confining the patient strictly to bed, by avoiding as far as possible all forms of exertion and excitement, and by the administration of sedatives. No local treatment should be adopted. After the first examination, from which it has been recognised that the abortion is not inevitable, no further vaginal examination should be made unless the case proceeds unfavourably. The diet should be kept low and no alcohol given; the bowels not allowed to become confined. Various sedative drugs may be administered, some of which are general, others special in their action. The usefulness of opium in all forms of hæmorrhage must not be overlooked, and small repeated doses in the form of laudanum or opium pill may be administered with great advantage. Bromide of potassium and chloral hydrate are especially useful in patients of excitable temperament. Certain drugs are believed to exert a specific sedative effect upon the uterus; among them may be mentioned viburnum, cannabis indica, and ergot in small doses. Viburnum may be given in the form of extract (2–3 gr.) or liquid extract (ʒss. to ʒj. in hot water every two to three hours). Cannabis indica is best given in the form of pills (½ to 1 gr. of extract). Ergot in small doses (10-15♏ of ext. ergotæ liq.) checks hæmorrhage without exerting that excitant action upon the uterine muscle which it manifests when given in large doses to parturient women (see p. 323).

A case of threatened abortion may at any time become inevitable, requiring a prompt change of treatment. In any case where the amount of bleeding is sufficiently profuse seriously to affect the patient's condition, the treatment of inevitable abortion must be adopted, even if there is no dilatation of the cervix.

Inevitable Abortion.—In many cases this process will proceed naturally, and terminate without any interference on the part of the medical practitioner, and with a perfectly favourable result. Under such circumstances nothing is required beyond the administration of ergot in full doses (ʒj. of liquid extract or 3 gr. of ergotine every four hours), which is useful in stimulating the uterus, preventing retention of fragments of the decidua or ovum, and ensuring proper retraction afterwards. It must be understood that the management of an abortion calls for the greatest possible care in the prevention of infection, and the antiseptic routine to be described later on for the management of normal labour (see p. 217) must be applied just as thoroughly and conscientiously to a case of abortion. The results of infection may be quite as serious or even as disastrous as those of ordinary puerperal infection.

Interference in an inevitable abortion may become necessary from excessive hæmorrhage, from rise of temperature, or from inability of the uterus to expel its contents. *Hæmorrhage* may become profuse or even dangerous at any stage of the process; it is of course due in the early stages to the separation of the ovum from the uterine wall and the consequent rupture of maternal vessels. The hæmorrhage abates to some extent when the ovum has been completely separated, even when it is not yet expelled from the uterine cavity; but while any portion remains undetached it will continue. *Rise of temperature* during a miscarriage necessarily arouses suspicion of infection, and is always to be regarded as an indication for terminating the process without delay. Finally, from *slow dilatation* of the cervix, from morbid adhesion of some part of the ovum, or from *weak contractions* the abortion may be so much delayed as to require interference.

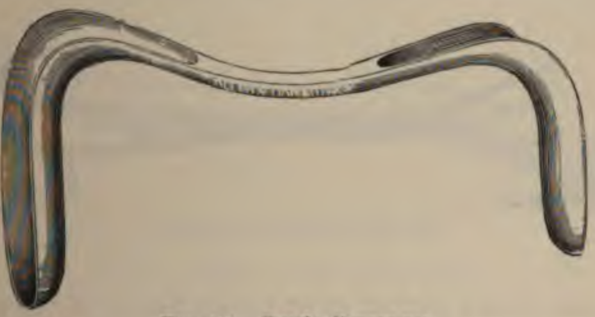

FIG. 75.—SIMS'S SPECULUM.

The method of interference to be adopted mainly depends upon the condition of the cervix. If not dilated sufficiently to admit the finger, the best treatment is to plug the cervix and vagina; if, however, the finger can be introduced, the uterus should be at once completely evacuated.

Vaginal Plugging (*Tamponade*).—The object of this mode of treatment is temporarily to arrest the bleeding, while allowing time for dilatation of the cervix to be completed. Plugging should be performed in the following manner.

An antiseptic vaginal douche (lysol ℥ss. to Oj.) should first be given, and the whole proceeding then carried through with careful antiseptic precautions. The patient should lie upon her left side in the Sims's position, or upon her back, the buttocks being drawn over the edge of the bed; a duck-bill (Sims's) speculum should then be passed and used to pull back the perineum and open the vulval aperture. With a pair of volsella forceps (fig. 76) the anterior lip of the cervix is then seized and held steady, while with a long probe a narrow strip of iodoform gauze is pushed through the cervical canal into the uterus, until the cervix is tightly filled with it. Then the vaginal fornices should be packed tightly with a second broader strip, a considerable length being required, and finally the lower part of the vaginal canal loosely filled. If the vagina is tightly packed down to the vulva, considerable pain will result, and the patient will probably be unable to evacuate her bladder. Strips of linen, first boiled for ten minutes and then soaked in an antiseptic solution, may be employed if iodoform gauze is not at hand. The only difficult part of the procedure is the passage of the gauze into the cervix, and this may be omitted if the necessary appliances are not at hand or if dilatation has not begun; the vaginal fornices can be readily packed with the aid of a speculum and a probe, or of a probe alone.

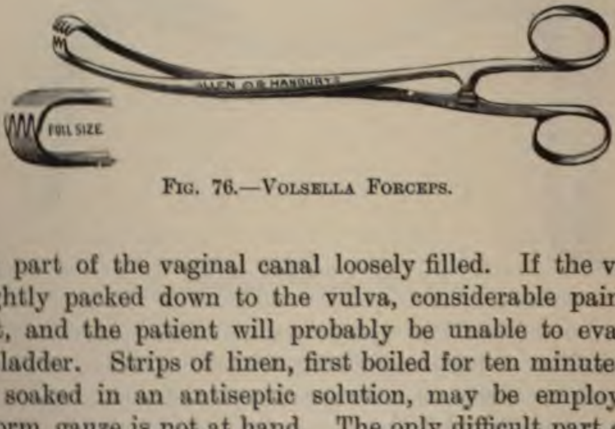

FIG. 76.—VOLSELLA FORCEPS.

The vaginal plug acts mainly as a foreign body reflexly exciting the uterine muscle to more powerful contractions; these contractions complete the separation of the ovum and dilate the cervix. Ergot should be administered freely while the plug is in position, and in six to eight hours it should be removed; the ovum will often be found lying in the vagina, and the uterus completely retracted and empty. Or the cervix may be sufficiently dilated to allow of immediate removal of the ovum if it has not already been expelled. Occasionally the plugging has to be repeated because the cervix is not sufficiently dilated, and the same careful antiseptic precautions must then be taken as at the first plugging.

Tents of laminaria or tupelo may also be used to dilate the cervix in abortion, but plugging is preferable since it more powerfully excites uterine contractions.

Evacuation of the Uterus.—When the cervix is sufficiently dilated to admit the index finger, the uterus may safely be cleared out without delay. Sometimes, when the condition of the patient becomes urgent, it is necessary to evacuate the uterus promptly whether the cervix is dilated or not.

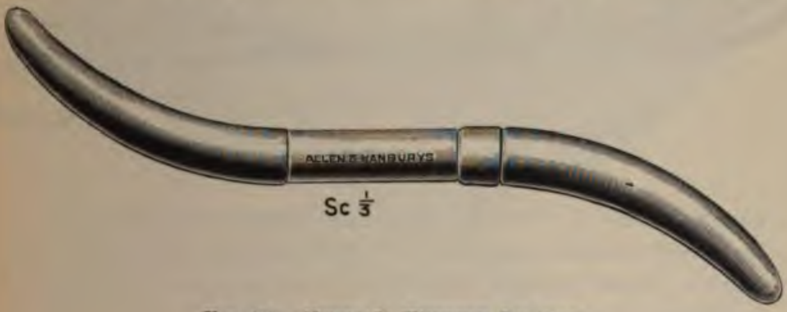

FIG. 77.—FENTON'S UTERINE DILATOR.

Under anæsthesia rapid dilatation may be performed by means of graduated metal cervical dilators (fig. 77) until the index finger can be introduced easily into the uterus. The uterine body should then be gently pressed down with one hand above the pubes, until the finger in the cervix can be worked thoroughly into the cavity. The ovum and the decidua must next be completely detached with the finger-tip, special attention being paid to the uterine angles. The finger should then be removed from the uterus, and by compressing the uterine body between the external hand and two fingers in the vagina, the whole contents may be squeezed out. If this should not succeed, a pair of blunt ovum forceps (fig. 78) may be passed into the uterus and the ovum removed piecemeal. It is unnecessary to use a curette. The finger should then again be passed to make sure that the uterus is completely empty, and finally both the uterus and vagina should be carefully douched with a hot antiseptic solution, such as lysol ʒj. to Oij. (temperature 115° F.), and loosely plugged with iodoform gauze. The strictest antiseptic precautions are called for in performing this simple operation.

The after-treatment of abortion is conducted upon the same principles as the normal puerperium (p. 399). Women of the poorer classes often pay little or no attention to a miscarriage; they do not seek medical advice, nor do they consider that a subsequent period of rest is necessary. But many forms of chronic pelvic inflammation arise from a neglected miscarriage, and it is the medical man's duty to enforce proper management and an adequate period—at least ten days—of rest in bed.

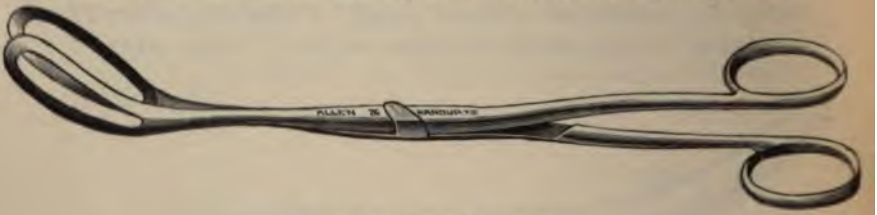

Fig. 78.—Ovum Forceps.

Death and Retention of the Fœtus in Utero

When an ovum perishes *in utero* during the first three or four months of pregnancy, the cause is usually to be found in the changes described in connection with fleshy or hydatidiform moles. At a later period it is not infrequent for the fœtus to perish *in utero* from various causes which do not lead to the production of gross anatomical changes in the placenta or membranes (fig. 79). In such cases the ovum may be retained in utero for many weeks before being expelled, and it then undergoes a series of well-defined changes which are practically the same at all periods of pregnancy. An ovum which has been retained for some weeks after the death of the fœtus, is often discharged entire; partial or complete absorption of liquor amnii occurs, which greatly reduces its bulk; the membranes are thickened and discoloured, while in twin pregnancy, with one fœtus surviving, the dead one may be compressed and distorted by pressure. The tissues undergo non-putrefactive necrosis; those first affected are the extra-placental structures—viz. the body of the fœtus, the umbilical cord, the amnion, and the chorion læve. The placental tissues preserve their vitality much longer, because the maternal circulation is only gradually cut off, and the villi therefore remain in contact

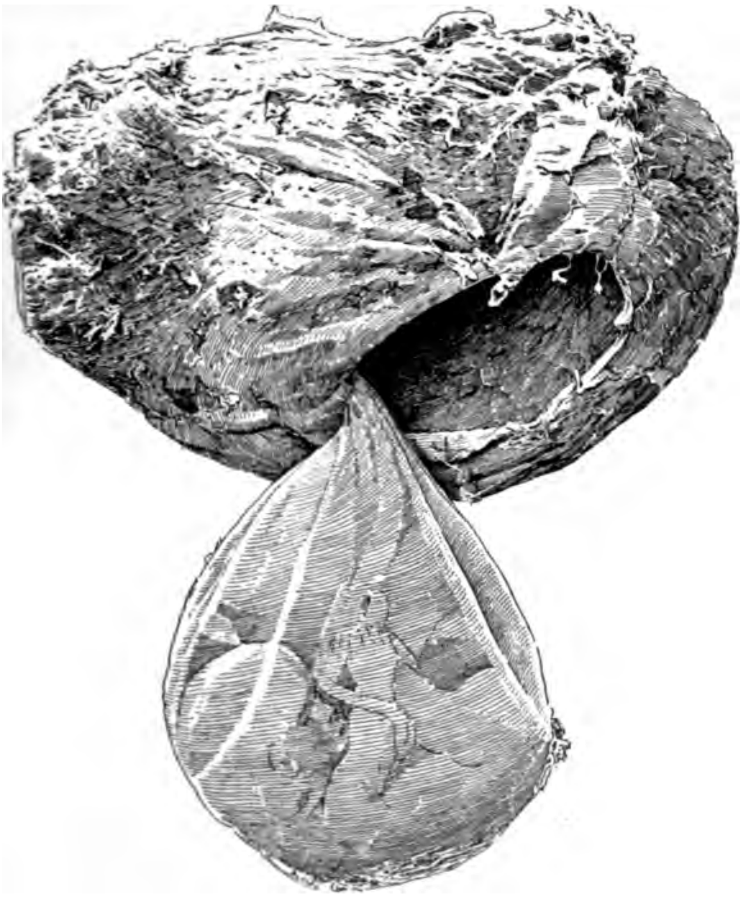

FIG. 79.—A COMPLETE OVUM OF THREE MONTHS' DEVELOPMENT, RETAINED FOR SOME WEEKS AFTER DEATH.

(CHARING CROSS HOSPITAL MUSEUM.)

An opening has been made in the chorion to show the fœtus in the amniotic sac.

with the normal source of their nutrition. Gradually, however, the inter-villous spaces become blocked by thrombosis, the villi necrose and lose all traces of their characteristic structures, until they become mere areas of structureless débris, preserving only their original shape. Lastly, extensive fatty and calcareous degenerations occur in all the tissues. The fluids of the fœtal body are gradually absorbed until the skeleton is plainly seen through the thin skin. In ova altered in this manner by post-mortem changes, it is extremely difficult to determine the primary lesion which caused the death of the fœtus.

The clinical *diagnosis* of death of the fœtus *in utero* can only be established by repeated examinations. The most reliable sign is cessation of growth of the uterus, and at least a fortnight is required to determine this with certainty, the normal rate of growth being about half an inch a week. Sometimes an actual diminution in size, from absorption of the fluid portion of the ovum, can be made out. The uterus is usually lax and flaccid, and it is difficult to excite contractions by manipulating it. During the last three months absence on repeated examinations of the heart-sounds is important, but no conclusion can be drawn from failure to hear them on a single occasion. Resolution of breast-changes can sometimes be made out, and is often remarked by the patient herself. Cessation of fœtal movements, as observed by the mother, must not be accepted as conclusive evidence unless confirmed by other signs. Other symptoms, such as a feeling of weight and cold in the abdomen, slight shivering, and slight general malaise may be complained of. Sometimes a brownish discharge from the uterus is observed, consisting of the liquefied débris of blood-clot or decidual tissue, but it is extremely rare for an ovum to undergo putrefaction *in utero*, except as the result of intra-uterine manipulation.

The *treatment* is expectant. Spontaneous expulsion will occur sooner or later, and there is no reason for interference except the patient's natural desire to get her labour over. At the same time it must be remembered that local signs of putrefaction render necessary immediate evacuation of the uterus.

PART III

NORMAL LABOUR

Labour is the process by which a fœtus of viable age is expelled from the uterus. Labour varies greatly in duration, in severity, and in the amount of risk to mother and child which it involves. By a *normal labour* is meant a case in which the fœtus presents by the vertex, and which terminates naturally, without artificial aid and without complications. Presentation is not the only criterion of normal labour, for even when the presentation is normal, complications may arise which carry the case at once into the category of *abnormal labour*. It follows that abnormal labour is somewhat difficult to define, but for practical purposes we may include under this designation all cases in which some other part than the vertex presents, and all vertex cases in which complications of maternal or fœtal origin arise.

The Clinical Phenomena of Normal Labour

The *onset* of normal labour occurs with approximate regularity at the fortieth week after the commencement of the last menstrual period, the average length of gestation, reckoned in this way, being from 274 to 280 days. The fortieth week is usually spoken of as 'term.' It is obvious that the date of the actual fertilisation of the ovum may not, and probably will not, correspond with the beginning of menstruation, so that this calculation does not give the actual gestation period; but no other practicable method of estimating it is available. The date of the expected confinement can best be fixed by counting up 274 or 280 days from the first day of the final menstrual period, as follows: Last menstruation January 31 to February 5.

February	28 (if leap year, 29)
March	31
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	7
	280

Therefore the confinement may be expected to take place between November 1 and 7.

The signs by which the onset of labour is recognised must be clearly understood. They are (1) painful uterine contractions; (2) slight uterine hæmorrhage – the 'show'; (3) commencing dilatation of the internal os; (4) formation of the 'bag of waters.'

(1) *Painful Uterine Contractions* (Labour Pains).—Reference has already been made to the fact that during the second half of pregnancy intermittent contractions, recognisable on palpation, occur in the wall of the gravid uterus. The patient is unconscious of them, and they produce no effect upon the cervix or ovum. At 'term' these contractions change their character and become labour pains; usually the transformation is gradual, vague, transient abdominal pain being complained of by the patient for several days; sometimes, however, a rapid or sudden onset of labour pains will be met with. At first they are slight, lasting for only half a minute, and separated by intervals of fifteen to thirty minutes; hey are then felt chiefly in the abdomen. More or less pidly they increase in number, severity, and duration. If abdomen is palpated during a pain, the whole uterus will elt to harden and become more clearly defined in outline. In women expecting to be confined, colicky abdominal ns, which may sometimes be mistaken by the patient for ur pains, are apt to occur from such trivial causes as

dyspepsia and constipation. They have received the somewhat inept name of 'false pains.' Pain of this description is not accompanied by dilatation of the internal os, and need therefore never be mistaken for labour; it is best treated by an aperient or an enema.

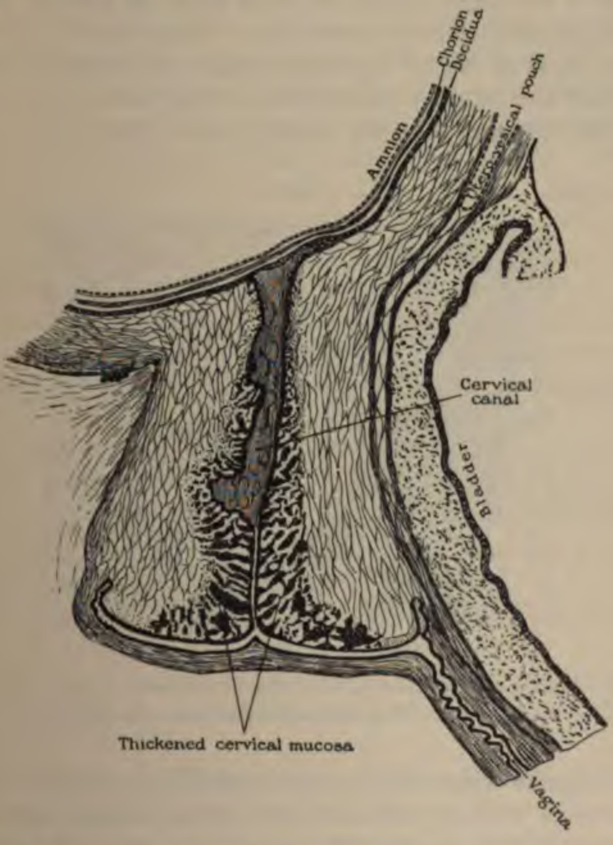

FIG. 80.—CERVIX OF A MULTIPARA AT TERM, BEFORE COMMENCEMENT OF LABOUR. FROM A FROZEN SECTION. (VARNIER.)

(2) *The 'Show'* is a discharge of slightly blood-stained
ucus. The mucus comes from the cervical mucosa, which
cretes abundantly during labour; the slight hæmorrhage
nes from the lower uterine segment, where the commence-
nt of dilatation causes a little separation of the membranes.
s not invariably met with, however, at the onset of labour.

(3) *Dilatation of the Internal Os.*—The usual condition of the cervix at term, before the onset of labour, is shown in fig. 80. From this figure it will be seen that the cervix is not shortened; the canal is intact and closed at both ends. In a multipara the external os is sometimes patulous, admitting the tip of the index finger, but even then the internal os will usually be found closed before labour. The alterations induced by the onset of labour are shown in fig. 81, where it will be seen that the cervix is shortened, and the canal open at both ends, the internal os being rather wider than the external.

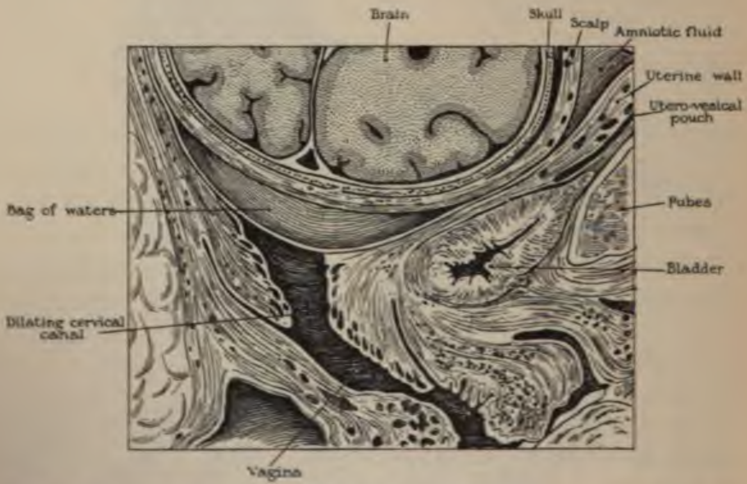

FIG. 81.—CERVIX OF A MULTIPARA WHO DIED OF ECLAMPSIA AT THE BEGINNING OF LABOUR. FROM A FROZEN SECTION. (VARNIER.)

These figures represent the actual conditions found in frozen sections of women who died, the former before labour, the latter soon after its commencement; they have therefore the value of precise anatomical observations. It will be noticed that the dilatation of the internal os is of necessity accompanied by a corresponding stretching of the lowest part of the lower uterine segment.

(4) *Formation of the 'Bag of Waters.'*—When the cervix opens, the lower pole of the fœtal membranes (chorion and amnion), being unsupported, tends to bulge into the cervical canal. It contains a little liquor amnii which has passed below the presenting part, and it has therefore received the

name of the 'bag of waters.' When the finger is passed into the cervix during a pain, this bag will be found to be convex in outline and tense in consistence; as the pain passes off it becomes less tense and less distinct, and may even disappear altogether as the membranes come into contact again with the head.

Notwithstanding these points, it is at times somewhat difficult to decide from a single examination whether a patient is actually in labour or not. Pains sufficient to open the internal os may occur, and then cease, several days or even two or three weeks elapsing before the actual onset of labour. During this time the cervix remains partially dilated. Again, the patient may complain of intermittent pains, and uterine contractions may actually be felt on palpation, yet there may be no dilatation of the cervix at all. Even when no pains have occurred the internal os may occasionally be found to be open at term both in a multipara and a primigravida, but this condition is much rarer in the latter than in the former. It follows that neither painful contractions alone, nor dilatation of the cervix alone, suffices for recognising that labour is actually in progress. But if with intermittent pains and dilatation the bag of waters is felt to grow tense during the pain, and to relax during the interval, the diagnosis of labour is certain.

The Stages of Labour.—In this country it is usual to divide the process of labour into three stages. In most instances these stages can be clinically defined with approximate accuracy, but sometimes cases occur in which this is impossible.

First Stage, or Stage of Dilatation.—This stage is preparatory to the actual process of birth—*i.e.* the expulsion of the fœtus from the uterus. It consists in the dilatation or canalisation of the lower uterine segment and cervix. Clinically its progress can be judged by the changes taking place in the os externum and the bag of waters. When in a multipara the os externum is patulous at the commencement of labour, as the internal os opens the cervical canal is rapidly taken up into the expanding lower uterine segment (fig. 82). In a primigravida the os externum sometimes does not dilate until the upper part of the cervical canal has become merged in the lower segment and the presenting part actually lies within it. The os is then felt as a small aperture with firm edges upon the summit of the convexity formed by the distended cervix. But as a rule the bag of waters bulges slightly through the dilating external os in the shape of an inverted watch-glass (figs. 81 and 82); the amount of fluid it contains varies considerably, and upon this its size and shape depend. When, as sometimes happens, the membranes rupture before the onset of labour, no bag is as a rule formed, although exceptions to this may be met with (see p. 326). When dilatation is complete the diameter of the cervix is nearly four inches, the presenting part occupies the whole cervical canal, and the edges of the os externum can be felt surrounding it. At this period the bag of waters usually ruptures spontaneously, and a certain amount of liquor amnii escapes, but the greater part is retained in the uterus, the presenting part filling the lower uterine segment and thus acting as a ball-valve. Sometimes,

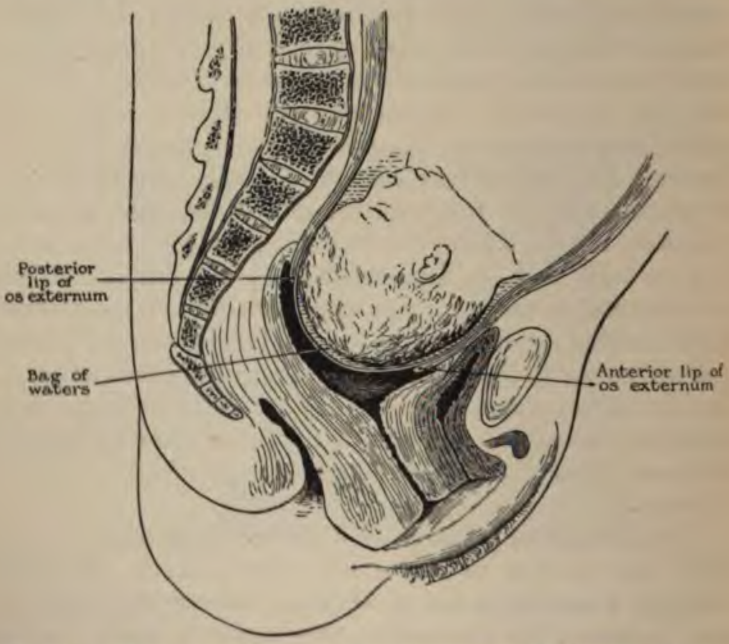

FIG. 82.—END OF THE FIRST STAGE OF LABOUR. THE LOWER UTERINE SEGMENT, CERVIX, AND UPPER PART OF THE VAGINA ARE DILATED. (MODIFIED FROM RIBEMONT-DESSAIGNES AND LEPAGE.)

however, rupture of the membranes occurs prematurely in the first stage, or, on the other hand, it may be delayed until the second stage is considerably advanced; in exceptional cases it may not occur at all, the bag protruding at the vulva and the head being delivered enclosed in the membranes. As a rule, however, the chorion ruptures in such cases, allowing the amnion to protrude through it, and it is the latter membrane alone which presents at the vulva.

The duration of this stage is variable, being usually much longer in a primigravida than in a multipara. Its average may be stated as sixteen hours in the former, and eight hours in the latter. The patient suffers throughout from intermittent pain, felt chiefly in the abdomen, occurring at more or less regular intervals of from three to five minutes; frequently there is vomiting in this stage, but the pulse and temperature remain normal.

Second Stage, or Stage of Expulsion.—This stage begins at the time when dilatation of the cervix is complete, whether accompanied by rupture of the membranes or not; it ends with the complete expulsion of the child from the birth-canal. The presenting part now passes from the cervix into the vagina, and on examination the lips of the os externum can be no longer felt. It will be observed that during this stage the vagina becomes gradually dilated from above downwards (fig. 82) by the passage through it of the head and body of the fœtus. The condition of the birth-canal towards the end of the second stage, but before the actual expulsion of the child, is seen in fig. 83, which shows that the uterus, cervix, and vagina have been merged into a single broad channel, the boundaries between the component parts having been obliterated.

The expulsion of the child is accomplished by the uterus, strongly reinforced by the voluntary muscles, which are vigorously used by the patient. The participation of the voluntary muscles is the chief factor in causing the characteristic feature of the pains of the second stage. The onset of each pain is accompanied by a deep inspiration, followed by straining or 'bearing down,' in which the patient holds her breath and employs her diaphragm, abdominal and back muscles, and sometimes apparently all the muscles in her body. The face becomes congested, the pulse quickened, she perspires a little [illegible] and last longer during the pains. They are much stronger and recur more frequently than those of the first stage.

When the head reaches the pelvic floor the first change observed in the external genitals is bulging of the perineal floor, which during the pains becomes somewhat convex externally and lengthened from anus to vulva. Next the

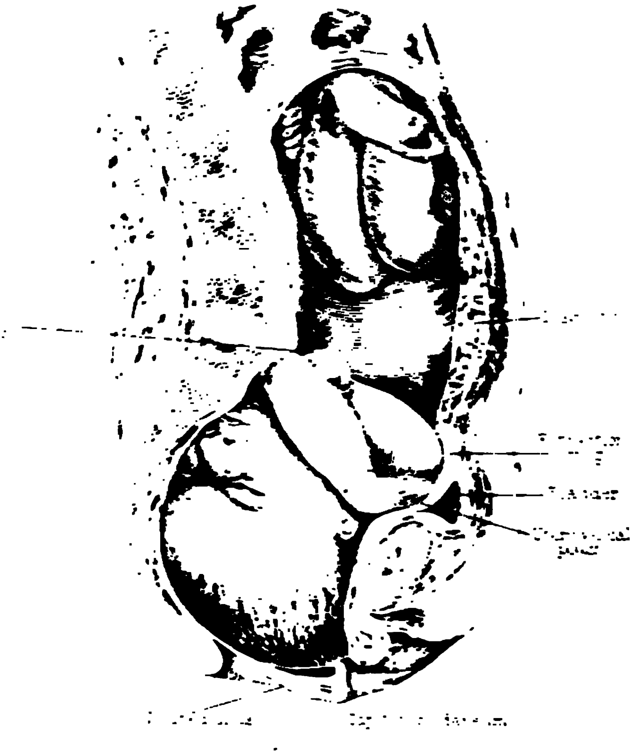

FIG. 83.—SECOND STAGE OF LABOR. FROM A FROZEN SECTION. (BARBOUR.)

anus becomes turgid and dilates slightly, and the hairy scalp appears at the vulva (fig. 84). As each pain passes off, the parts resume their normal appearance. When the head is about to emerge the anus gapes widely, exposing one to two inches of the anterior rectal wall. The posterior commissure becomes greatly thinned as the vulva stretches, and [illegible]rtain amount of laceration of the posterior wall of the

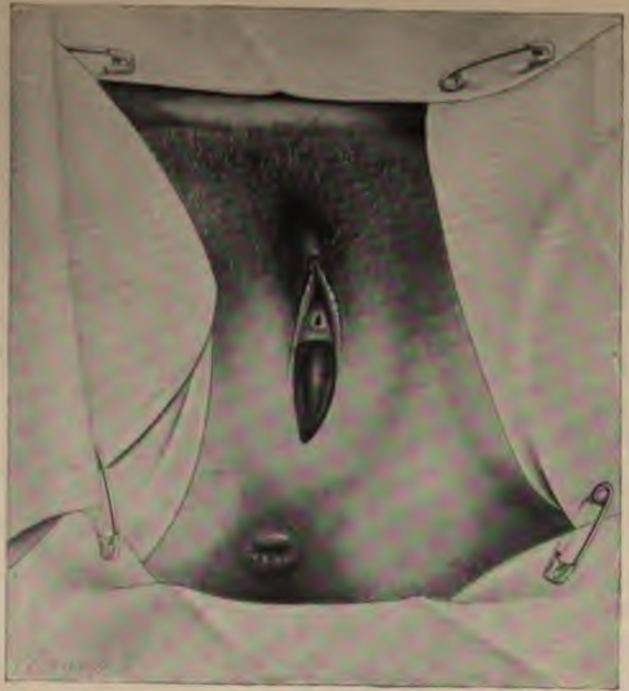

FIG. 84.—BIRTH OF HEAD: SCALP APPEARING AT VULVA
(WHITRIDGE WILLIAMS.)

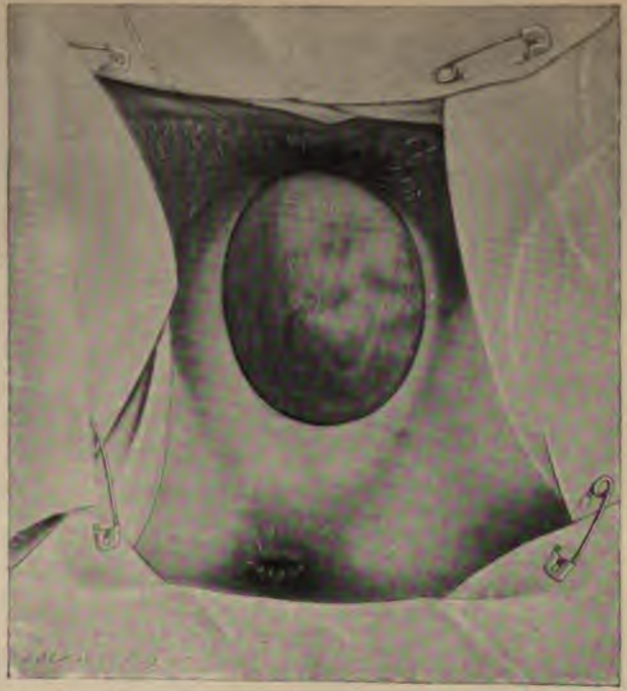

FIG. 85.—BIRTH OF HEAD: VULVA COMPLETELY DISTENDED.
(WHITRIDGE WILLIAMS.)

[*To face p.* 170.

ostium vaginæ may be expected to occur. This usually also involves the lower part of the posterior vaginal wall and at times the perineal body, which may in some instances be torn up to or including the anus. The actual expulsion of the head in a primipara is accomplished by a very prolonged and severe contraction, or by a series of powerful contractions, accompanied by violent straining.

A short pause then occurs, to be succeeded in two or three minutes by a return of the pains, which expel first the shoulders, and then the trunk and lower extremities. In the case of a large fœtus, the expulsion of the shoulders may cause as much laceration of the vulva as the delivery of the head. As the body escapes a rush of blood-stained liquor amnii follows, representing the portion of fluid which has been retained in the uterus behind the presenting part. The second stage lasts on an average three hours in a primigravida; in a multipara it is often very short, lasting only ten to fifteen minutes when the uterus acts powerfully; but it may last very much longer than this when the pains are relatively feeble.

Third Stage, or Delivery of the After-birth.—The after-birth consists of the placenta, umbilical cord, and membranes; the latter include the amnion, chorion, and sometimes the remains of the decidua vera.

Following upon the expulsion of the fœtus, the uterus undergoes a sudden and striking diminution in size. The fundus now lies about the level of the umbilicus, and the uterus appears to be about as large as the fœtal head. It will be observed to vary gradually in consistence, becoming alternately harder and softer to the touch; this signifies that intermittent contractions are continuing, but they are practically painless, and the patient is usually unconscious of them. After a period varying on an average from ten to thirty minutes, certain changes occur which indicate that the placenta has been detached from the uterine wall and driven into the lower uterine segment and cervix, or into the vagina. The uterus becomes smaller, harder, and more globular in shape; the level of the fundus, which is hard and retracted, rises, while the lower segment, plainly felt above the pubes, is soft and bulging from the presence in it of the placenta. It may also be noticed that a longer piece of the umbilical cord lies outside the vulva than before. A certain amount of hæmorrhage always accompanies the process of separation of the placenta. Expulsion is usually accomplished by a voluntary effort on the part of the patient, when the placenta appears at the vulva and can be withdrawn by the attendant; a considerable amount of blood-clot often follows it.

The uterus is now about the size of a cricket-ball, and should remain almost uniformly firm and hard; but for half an hour after labour intermittent contraction and relaxation can often be recognised, and while these continue there is risk of hæmorrhage.

The Anatomy and Physiology of the First and Second Stages of Labour

In this section will be described (I.) the maternal passages and the effects of labour upon them; (II.) the fœtus at term and the effects of labour upon it; (III.) the forces of labour their mode of action, and their influence upon the general physiological functions of the mother.

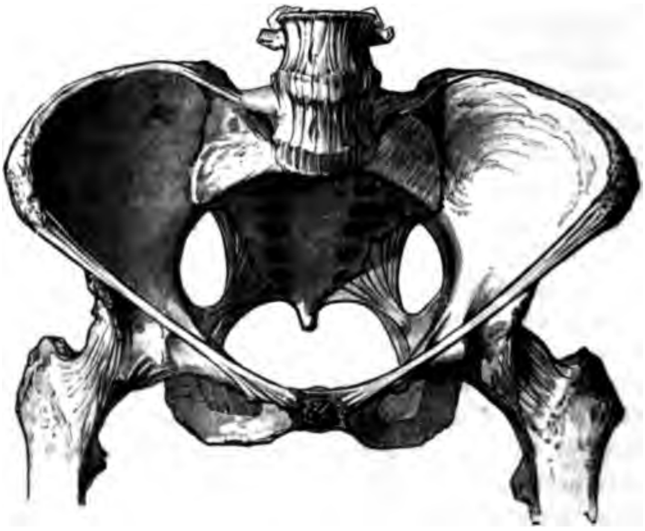

FIG. 86.—FEMALE PELVIS.

I. **The Maternal Passages.**—These comprise the bony canal with the soft structures which line it and close in its outlet.

A description of the general anatomy of the pelvis is unnecessary in a text-book of midwifery; it will, however, be useful to recall the points of difference between the male and female pelvis (figs. 86 and 87). In the female the bones are more slender and the muscular impressions less pronounced. The false pelvis (the part above the pelvic brim, and bounded laterally by the iliac bones) is somewhat more capacious in the female than in the male, the anterior-superior iliac spines being a little further apart, and the iliac fossæ looking more directly forwards. In the female the true pelvis is somewhat more capacious, though a little shallower; the sacral promontory projects less into the brim; the sacrum is rather less concave anteriorly; the pelvic outlet is considerably larger in all its diameters, and the pubic arch forms a much more obtuse angle. Sometimes a female pelvis approximates to the male characteristics, leading to a certain amount of difficulty in labour.

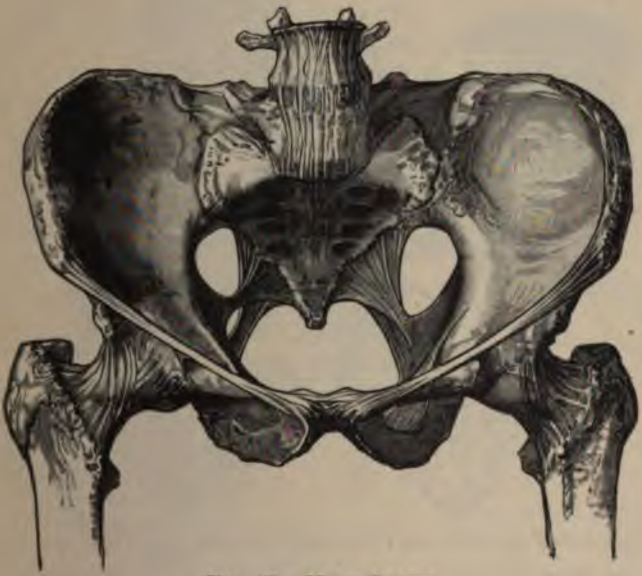

FIG. 87.—MALE PELVIS.

With the *false* pelvis we have little concern except that its dimensions are of service in indicating the shape and size of the true pelvis; these will be mentioned in describing clinical pelvimetry (p. 290). The *true* pelvis is divided for systematic description into three parts—viz. the *brim*, the *outlet*, and the *cavity*.

The *pelvic brim* or *inlet*, or *upper pelvic strait*, is the plane of division between the false and the true pelvis (figs. 86 and 88). It may be traced from the centre of the upper border of the symphysis pubis (*b*) along the pubic crest, past the pubic spine to the ilio-pectineal eminence (*f*), thence along the iliac portion of the ilio-pectineal line to the sacro-iliac synchondrosis (*g*), thence along the ala of the sacrum to the centre of the sacral promontory (*a*). Its shape is that of a transverse oval, with a slight posterior constriction caused by the promontory of the sacrum (*i.e.* it is roughly cordate, fig. 92). We have to consider its *plane*, its *inclination*, its *axis*, and its *diameters*. The *plane* of the pelvic brim is an imaginary flat surface bounded by the limits just mentioned as those of the brim; it is convenient to speak of the presenting part of the fœtus as lying above, or below, or in the plane of the brim. The plane of the brim is not, in the erect position of the body, a horizontal surface, but, owing to the oblique articulation

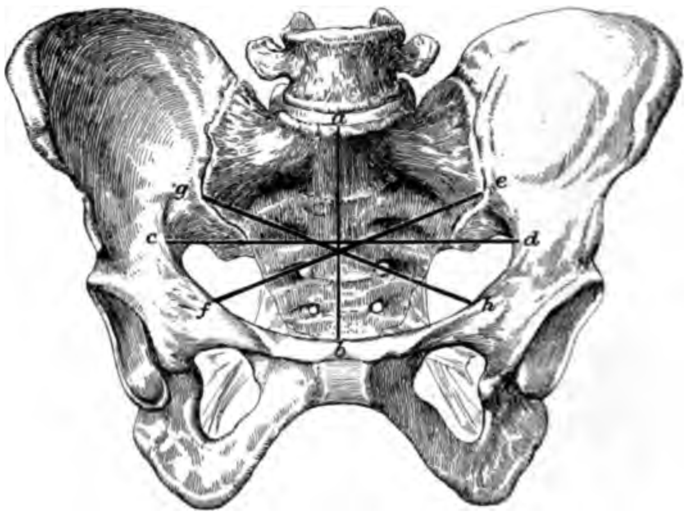

FIG. 88.—THE FEMALE PELVIS: OUTLINE OF PELVIC BRIM, *a, e, d, h, b, f, c, g*.

a, b. Conjugate diameter. *c, d.* Transverse diameter. *e, f.* Left oblique diameter. *g, h.* Right oblique diameter.

of the pelvis with the femora, it is inclined at an acute angle to the horizon; this is its *inclination*. This will be clear from fig. 89 (*a*), which represents a bisected pelvis, placed in the position it would occupy in the erect attitude. The general inclination of the line of the brim is well seen. The same points are shown diagramatically in fig. 89 (*b*), which shows that the angle of inclination in the erect position is 55°.

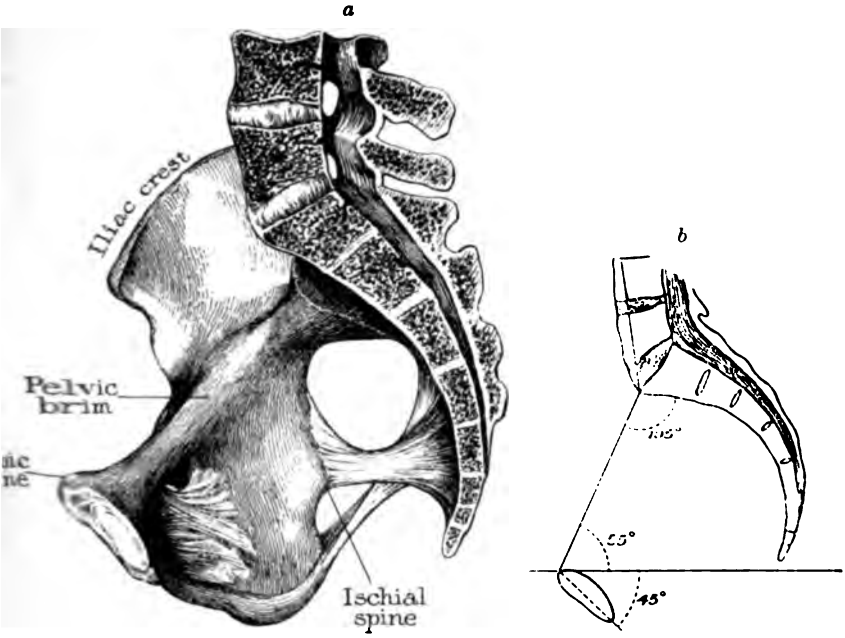

Fig. 89.—(*a*) A Bisected Pelvis, as in the Erect Position, showing the Inclination of the Pelvic Brim. (*b*) The Same Represented Diagrammatically.

The posterior border of the brim accordingly stands at a higher level than the anterior, the sacral promontory being about 3¾ inches above the upper border of the symphysis pubis in the erect position. It must also be observed that the surface of the body of the pubes is not vertical, but almost parallel to the axis of the brim. The *axis* of the brim will be represented by an imaginary straight line drawn perpendicular to the plane of the brim at its centre; this being produced upwards and downwards, will pass from the umbilicus to the tip of the coccyx (fig. 91). This line indicates the direction in which a body passing through the pelvic brim must travel. Four *diameters* of the pelvic brim are described; it must be recollected that they are skeletal measurements and represent the average of a large number of specimens. The antero-posterior diameter or *conjugate* is measured from the centre of the sacral promontory behind to the nearest point in the middle line upon the posterior surface of the symphysis pubis in front (fig. 88, *a*, *b*). This diameter is also called the *obstetric* or *true conjugate*, to distinguish it from certain clinical measurements to be afterwards described, which are also called conjugates. The two *oblique* diameters are measured from the sacro-iliac synchondrosis behind to the ilio-pectineal eminence on the opposite side; the right oblique is that taken from the right sacro-iliac joint (*g*, *h*), the left from the left sacro-iliac joint (*e*, *f*). A *transverse* diameter is also described, being the distance between the two furthest apart points of the pelvic brim (*e*, *d*); this line lies nearer the sacrum than the pubes, and is not, strictly speaking, a *diameter* at all, since it does not pass through the centre.

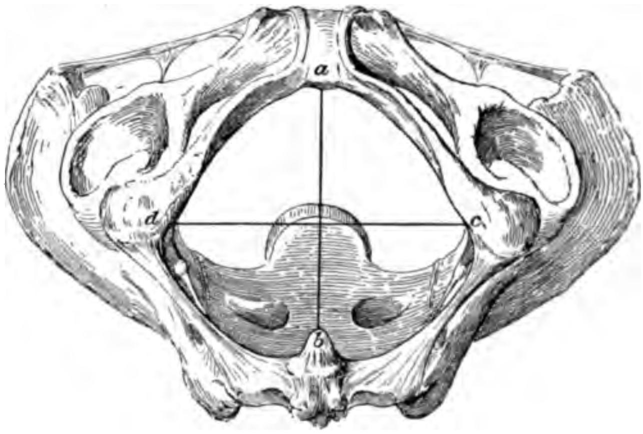

FIG. 90.—THE PELVIC OUTLET; LOWER PELVIC STRAIT.
a, *b*. Antero-posterior diameter. *c*, *d*. Transverse diameter.

The *pelvic outlet* or *lower pelvic strait* is a lozenge-shaped space bounded in front by the lower border of the symphysis pubis; laterally by the pubic arch, the ischial tuberosities, the ischial spines, and the greater and lesser sacro-sciatic ligaments; posteriorly by the coccyx (fig. 90). These boundaries do not lie in a single plane; hence, strictly speaking, the *plane of the outlet* does not exist, for its lateral boundaries lie at a lower level than the front and back. It is of great practical importance, however, to determine the *axis* of the outlet, and it has consequently been agreed to describe its *plane* as the imaginary flat surface bounded in front by the centre of the pubic arch, laterally by the tips of the ischial spines (fig. 89), and posteriorly by the lower border of the last sacral vertebra. As thus defined, its shape is that of an antero-posterior oval (fig. 92). Its *axis* will be represented by a line joining the centre of its plane with the sacral promontory—a line much more nearly vertical than the axis of the brim (fig. 91). Only two diameters can be described: the *antero-posterior*, taken from the centre of the lower border of the symphysis to the tip of the last sacral vertebra (fig. 90); and the *transverse* between the inner borders of the ischial tuberosities. Oblique diameters cannot be defined, as the pelvic outlet between the ischial tuberosities and the coccygeal border is filled in with

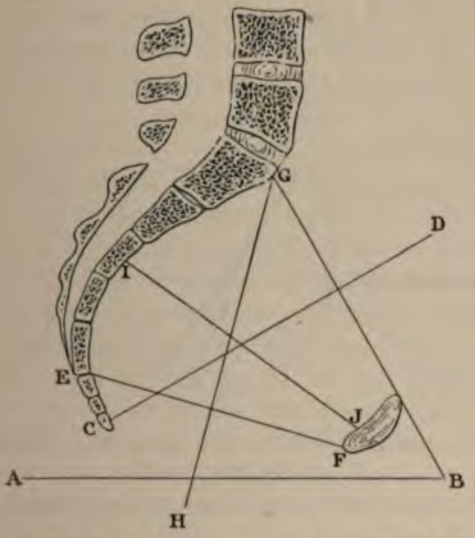

FIG. 91.—THE PLANES AND AXES OF THE NORMAL PELVIS.

A, B. Horizontal line. G, B. Plane of the brim. J, I. Plane of the mid-cavity. F, E. Plane of the outlet. D, C. Axis of the brim. G, H, Axis of the outlet.

soft structures only, and the diameters we are considering are skeletal.

The *pelvic cavity* is the space between the plane of the brim above and the plane of the outlet below. It forms a curved canal with a shallow anterior and a deep posterior wall; the former measuring one and a-half inch, the latter four and a-half inches; its lateral walls are about four inches deep. It is obvious that a number of *planes* of the cavity, taken at different levels, might be described, but it suffices to determine a single one—the *mid-plane*, bounded in front by the centre of the symphysis pubis, and behind by the junction of the second and third sacral vertebræ. Its shape

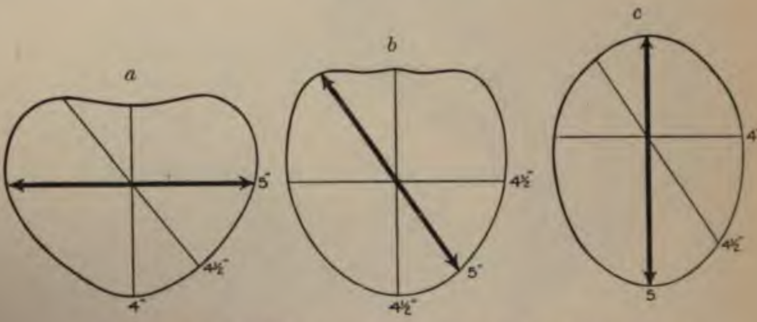

FIG. 92.—THE PLANES (*a*) OF THE BRIM, (*b*) OF THE CAVITY, (*c*) OF THE OUTLET.

The double-headed arrow represents the longest diameter.

is intermediate between that of the brim and the outlet (fig. 92). Its *antero-posterior diameter* is measured from the points just mentioned, its *transverse diameter* across the widest part; *oblique diameters* cannot be precisely defined, owing to the soft structures filling in the sacro-sciatic notches. The *axis* of the mid-plane of the cavity is represented by a line,
direction of which is intermediate between those of the
and the outlet. By uniting the axes of the three planes
brim, mid-cavity, and outlet, a line is formed which
verse the centre of the canal of the bony pelvis
It forms a curve, concave anteriorly, and directed
ownwards and backwards (axis of brim), then gradu-
e and more forwards until it reaches the axis of the
It is of great service in the systematic description

of labour, but does not strictly follow the centre of the canal, as no allowance is made for the irregular curvature of the anterior surface of the sacrum. This line is known as the *axis of the pelvis* or curve of Carus; in labour it becomes modified by displacement of the pelvic floor, and will be again referred to in that connection.

The average length of the diameters of the bony pelvis is as follows:

	Ant.-Post.	Oblique	Transverse
Brim (plane) . .	4¼ in. (10·5 cm.)	4¾ in. (12 cm.)	5¼ in. (13 cm.)
Cavity (mid-plane) .	4¾ „ (12 „)	5 „ (12·5 „)	4¾ „ (12 „)
Outlet (plane) . .	5¼ „ (13 „)	4½ „ (11·5 „)	4¼ „ (10·5 „)

The oblique diameters of the cavity and outlet are approximate, for the reasons already mentioned. The antero-posterior diameter of the outlet is clinically measured from the lower border of the symphysis to the tip of the coccyx instead of to the lower border of the last sacral vertebra. With the coccyx pushed back to the fullest possible extent in the position it assumes in normal labour when the fœtal head passes through, it measures five and a-quarter inches; with the coccyx in its normal position it is three-quarters to one inch less than this.

These diameters are reduced by the soft structures which line the pelvic walls and by the viscera contained within the pelvis. The ilio-psoas and obturator internus muscles reduce the transverse and oblique diameters at the brim. The pelvic colon and upper part of the rectum lie in the left oblique diameter both of the brim and the cavity; in parturient women the conjugate of the brim passes through the urethra and through both walls of the cervix, which diminish the space available for the accommodation of the presenting part of the fœtus. Frozen sections show that in the second stage the available space in the conjugate diameter is thus diminished, at the brim from a-quarter to half an inch, in the cavity from a-half to three-quarters of an inch.

The *pelvic floor* comprises the soft parts which fill in the pelvic outlet. For a general description of the structures of which it is composed a text-book of anatomy should be consulted; we are only concerned with the changes which it undergoes during labour.

Under ordinary conditions the outer or lower surface of the pelvic floor (the anatomical *perineum*) is somewhat convex, the centre of the perineal body being one and a-quarter inch below the level of a line joining the lower border of the symphysis with the tip of the coccyx. The usual *projection* of the pelvic floor is, therefore, one and a-quarter inch. Three canals pierce it—viz. the urethra, the vagina, and the rectum (fig. 93). The central canal, the vagina, becomes enormously dilated during the second stage of labour, and in consequence the whole disposition of the pelvic floor is altered. The dilatation of the vagina divides the pelvic floor into two sections: the anterior section, lying in front of the vagina, becomes drawn upwards; the posterior section, lying behind it, becomes displaced downwards and backwards, and the fœtus is expelled through the space thus opened up between them. The process has been aptly likened by Berry Hart to the act of passing through swing doors by pulling one door towards you and pushing the other away. The upward displacement of the anterior section is indicated by the alteration which occurs in the position of [illegible] urethra and bladder during the second stage of labour. [illegible]ring the first stage it remains a pelvic organ, and lies

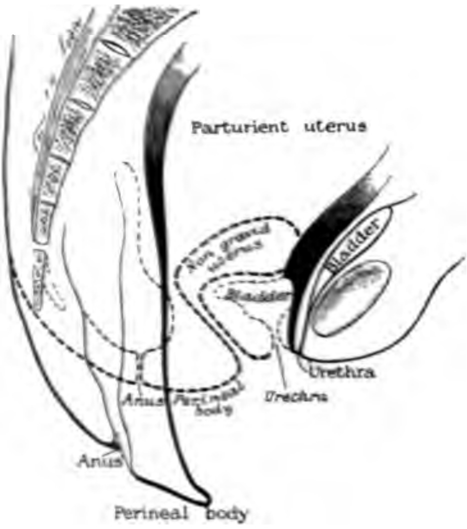

Fig. 93.—Schematic Representation of the Displacement of the Pelvic Floor in Labour. (Dakin.)

behind the symphysis pubis (fig. 81); in the second stage it becomes drawn up above the pubes into the abdomen, while the urethra is correspondingly elongated (fig. 82). The displacement of the posterior section has been described in connection with the clinical phenomena of the second stage of labour. The effects produced are diagrammatically shown in

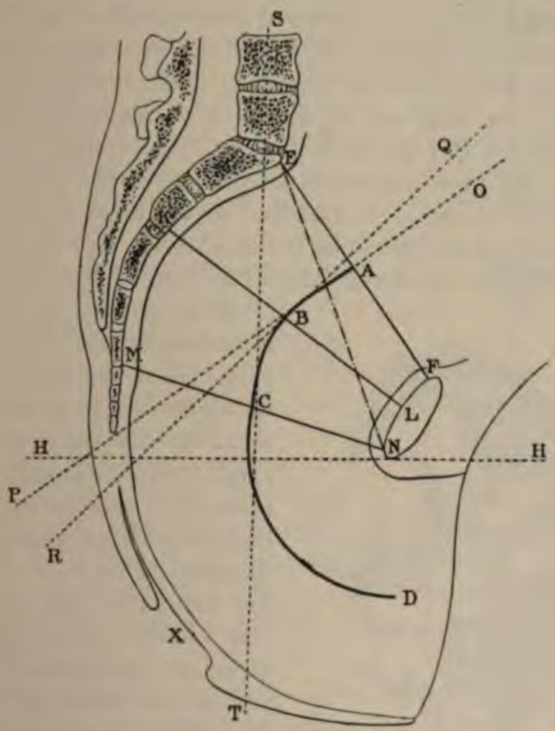

FIG. 94.—THE PELVIC AXIS OR CURVE OF CARUS. (GALABIN.)

E, F. Conjugate of the brim. E, N. Diagonal conjugate. L, K. Conjugate of the cavity (mid). N, M. Conjugate of the outlet. O, P. Axis of the brim. Q, R. Axis of the cavity. A, B, C, D. The pelvic axis. H, H. Horizontal line. S, T. Vertical line. X. Anus.

fig. 93. The fourchette is now the lowest part of the pelvic floor; it lies four inches below the coccygo-symphysial level; the *projection* of this portion of the pelvic floor has therefore been increased to four inches, and a wide aperture of exit provided for the fœtus. The effect of this displacement is to prolong the pelvic canal by the formation of a tube composed solely of soft parts below the level of the pelvic outlet; this prolongation, like the cavity of the true pelvis itself, has a shallow anterior wall, but deep posterior and lateral walls. Its relation to the bony canal is diagrammatically shown in fig. 94, from which it will be seen that the axis of the prolongation forms a continuation of the axis of the bony pelvis. The path to be followed by the fœtal head in passing through the pelvis is accordingly represented in full by the curved line A, B, C, D, representing the *axis of the pelvis* or the *curve of Carus*.

One other important relation of the structures composing the pelvic floor must be borne in mind. Anteriorly these structures are attached to the back of the pubic arch, and posteriorly to the tip and sides of the coccyx. Laterally, however, the most important constituent of the pelvic floor—viz. the pelvic fascia—is attached to the inner surface of the lateral walls of the ischia at the level of the tips of the ischial spines. At this level runs the white line of the pelvic fascia from which the fibres of the levator ani muscle arise. The pelvic floor therefore clothes the lower part of the lateral walls of the bony pelvis and slopes downwards and inwards from each side to the middle line, where it is pierced by the rectum and vagina. Owing to the inclination of the pelvis, the whole pelvic floor (but especially the posterior section) also slopes somewhat forwards (fig. 94); therefore the fœtal head, when it reaches the pelvic floor, rests upon a sloping, not a horizontal, surface, the general direction of the slope being downwards, forwards, and inwards.

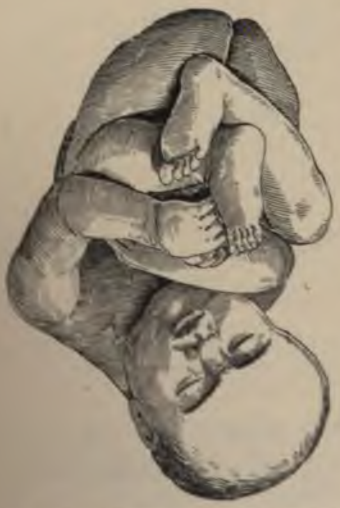

FIG. 95.—FŒTUS FROM A FROZEN SECTION, SHOWING THE GENERAL ATTITUDE OF THE FŒTUS, AND INCLINATION OF THE HEAD TO THE SHOULDER. (CLARENCE WEBSTER.)

II. **The Fœtus.**—Under this heading we have to consider (1) the disposition of the fœtus *in utero*; (2) the size and characters of the fœtal skull; and (3) the protective action of the bag of fluid in which the fœtus is contained.

(1) *The Disposition of the Fœtus.*—During the last weeks of pregnancy the head, trunk, and limbs of the fœtus are packed up into the smallest possible space in a regular and fairly constant arrangement, which is termed the fœtal *attitude*. This is best described as an attitude of general flexion (fig. 95), and the study of frozen sections has entirely removed this point from the field of speculation. The head is flexed so that the chin touches the anterior chest-wall; the arms are crossed more or less symmetrically below the chin; the thighs are fully flexed on the abdomen, the legs on the thighs, the feet on the legs, the latter being generally crossed, but sometimes lying side by side; and lastly the spine is flexed, the back forming a distinctly convex surface. Frozen sections show that the head is also usually inclined towards one or other shoulder whether the head presents or the breech; therefore when the head enters the pelvic brim one parietal bone lies at a lower level than the other (fig. 95). Any disturbance of this attitude usually involves some departure from the normal course of labour.

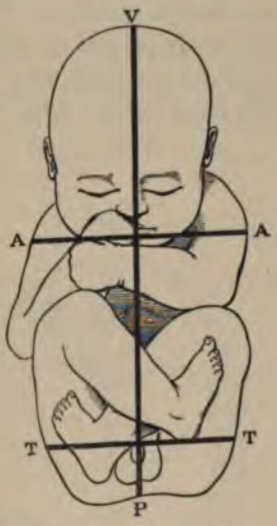

Fig. 96.—The Normal Attitude of Flexion (Diagrammatic). (Dakin.)

As thus disposed, the body of the fœtus forms an ovoid mass somewhat broader at the breech than at the head. The dimensions of the ovoid are as follows (fig. 96):

Vertico-podalic	diameter	(V-P)	9½ to 10 in. (24 to 25 cm.)
Bis-acromial	,,	(A-A)	4¾ ,, (12 cm.)
Bi-trochanteric	,,	(T-T)	4 ,, (10 cm.)

The widest transverse diameter is across the shoulders. The smallest circumference of the flexed head is about 11 inches (27·5 cm.); the circumference of the breech, both thighs being flexed, is about 13 inches (32·5 cm.).

From this it follows that the fœtal ovoid will adapt itself most easily to the ovoid shape of the uterine cavity at term when the head lies below and the breech above; the least convenient arrangement will be that in which the fœtal ovoid lies across the uterine ovoid. When the long axes of the fœtal and uterine ovoids correspond, the arrangement is called the *longitudinal lie*; of this there are two varieties—(*a*) that in which the head is below, and (*b*) that in which the breech is below. When the long axes do not correspond, the arrangement is called the *transverse* or *oblique lie.* In over 96 per cent. of all labours the lie is longitudinal with the head below; when this is the case, the part of the head which first enters the pelvic brim is in the great majority of cases the *vertex.* This arrangement is called in brief a *vertex presentation,* the first part to enter the brim being always termed the *presenting part.* Presentation of the vertex implies that the head is fairly well flexed, even if the chin does not rest on the chest. If this attitude is appreciably disturbed some other part of the head will present.

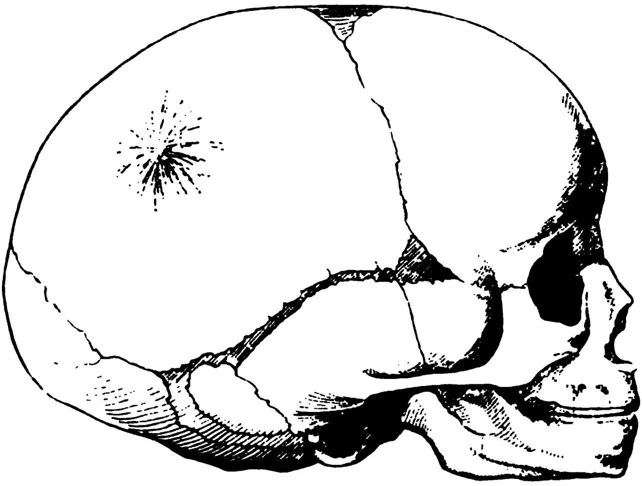

FIG. 97.—SIDE VIEW OF THE FŒTAL SKULL.

(2) *The Fœtal Skull.*—Since the head presents in such a preponderating proportion of cases, it must be studied in detail and in relation to the parturient canal through which it has to pass.

The ossification of the fœtal skull at term is incomplete, especially in the case of the bones which compose the vault.

While those of the base are firm and incompressible, the tabular bones of the vault remain thin and pliable, and are separated at their edges by intervals of unossified membrane forming the *sutures* and the *fontanelles*. The vault of the skull is consequently compressible, and in fact it becomes modified considerably, both in size and shape, by the pressure to which it is subjected during labour.

The *sagittal* suture crosses the vault of the skull in the middle line, lying between the two parietal bones (fig. 98, *b*); in the same plane in front of the anterior fontanelle runs the *frontal* suture, lying between the two halves of the frontal bone. The *coronal* suture separates the frontal from the parietal bones, meeting the sagittal and frontal sutures at the anterior fontanelle (fig. 97). The *lambdoidal* suture separates the parietal bones from the tabular portion of the occipital bone (fig. 98, *a*).

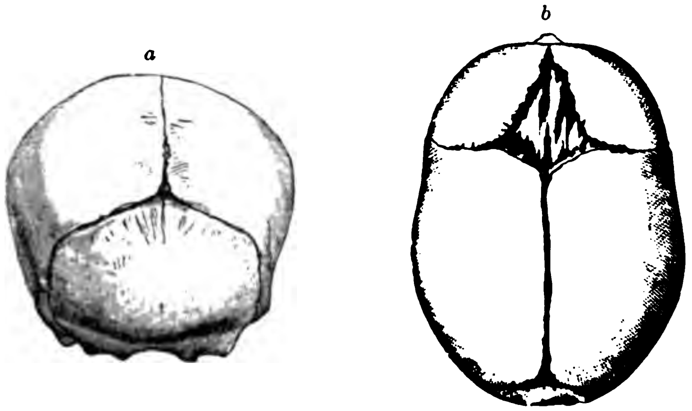

Fig. 98.—*a*, Fœtal Skull showing the Posterior Fontanelle. *b*, Fœtal Skull showing the Anterior Fontanelle. (Galabin.)

Four or five fontanelles exist in the skull at term, but only two of them are of practical importance in midwifery—viz. the anterior and posterior fontanelles. The *anterior fontanelle* or *bregma* is an unequal-sided lozenge-shaped piece of unossified membrane, lying in the mesial plane between the two frontal and the two parietal bones (fig. 98, *b*). Its angles are continuous with the frontal, the sagittal, and the right and left halves of the coronal sutures. The latter enter it considerably behind its centre. It measures one and a-quarter inch in antero-posterior and four-fifths of an inch in transverse diameter, and as it lies a little below the general level of the skull, it can be felt on the surface as a shallow depression. The *posterior fontanelle* is not as a rule an unossified piece of membrane at all, but a triangular depression produced by the angle of the tabular portion of the occipital bone being slightly depressed below the level of the posterior borders of the parietal bones with which it comes in contact (fig. 98, *a*). This depression lies at the point of junction of the sagittal suture with the right and left halves of the lambdoidal suture. In a premature fœtus, however, an unossified piece of membrane often persists at the posterior fontanelle.

These two fontanelles are of importance because they can be recognised by touch during labour, and from them valuable information can be obtained as to the position and attitude of the fœtal head. The anterior can be recognised by its lozenge shape, its soft membranous floor, and the presence of four sutures running from its angles. The frontal can be distinguished from the sagittal end of this fontanelle by its greater width. The posterior is triangular in shape, has a hard floor, a raised edge (parietal), and is connected with only three sutures.

The general shape of the fœtal head is that of an ovoid with a long antero-posterior diameter (fig. 97). In the normal attitude of complete flexion the long diameter of the head ovoid forms a very acute angle with that of the body ovoid; when the head lies midway between flexion and extension the two long diameters cross one another at right-angles; when the head is fully extended the angle formed is very obtuse and the face becomes the lowest part. The part of the circumference of the head which first comes into contact with the pelvic brim—*i.e.* the *girdle of contact*—varies with the degree of flexion or extension which may be present, and accordingly the diameter of the girdle of contact (*diameter of engagement*) also varies. In passing from the position of complete flexion to that of complete extension the diameters of the successive girdles of contact are as follows:

	Length		Presentation
1. Sub-occipito-bregmatic (S.-o.-b.) (nape of neck to centre of bregma)	3¾ in.	(9·50 cm.)	Completely flexed vertex
2. Sub-occipito-frontal (S.-o.-f.) (nape of neck to anterior end of bregma)	4 in.	(10·00 cm.)	Incompletely flexed vertex
3. Occipito-frontal (O.-f.) (occip. protuberance to root of nose)	4½ in.	(11·25 cm.)	Extended vertex
4. Mento-vertical (M.-v.) (point of chin to centre of sagittal suture)	5½ in.	(13·75 cm.)	Brow presentation
5. Sub-mento-vertical (S.-m.-v.) (angle between neck and chin to centre of sagittal suture)	4½ in.	(11·25 cm.)	Incompletely extended face
6. Sub-mento-bregmatic (S.-m.-b.) (angle between neck and chin to centre of bregma)	3¾ in.	(9·50 cm.)	Completely extended face

In addition to the above, three transverse diameters of the head are of importance: (1) the *bi-parietal* (3¾ inches—9·50 cm.), between the two parietal eminences; (2) the *bi-temporal* (3¼ inches—8 cm.), between the anterior ends of the coronal suture; (3) the *bi-mastoid* (2¾ inches—7 cm.), between the tips of the mastoid processes. The circumference of the head varies in different planes; the smallest circumference is that of the sub-occipito-bregmatic plane, which measures eleven inches.

It must be recollected that all diameters which involve the vault are compressible, and can be reduced in length to an appreciable extent during the passage of the head through the pelvis.

(3) *The Liquor Amnii.*—During the greater part of the process of labour the fœtus is protected from pressure by the liquor amnii at every part except the girdle of contact. The uterine contractions do not act directly upon the body of the fœtus until labour is far advanced and the liquor amnii has more or less completely escaped. The lower pole of the fœtal envelopes containing the fore-waters becomes detached from the lower uterine segment early in labour, and is driven down by the contractions into the cervix in advance of the presenting part of the fœtus. The mechanical value of this *bag of waters* as an aid to the dilatation of the cervix is very considerable, on account of its elasticity and its shape. When the cervix is dilated and the bag of waters is consequently

unsupported, the membranes, as a rule, can no longer resist the strain of the increased tension produced by the uterine contractions, and rupture accordingly takes place. The membranes may, however, when unusually weak, rupture before labour or early in the first stage; on the other hand, when unusually strong, spontaneous rupture may not take place at all, the bag of waters appearing at the vulva during the birth of the head.

In normal conditions the liquor amnii is sterile; it may, however, become infected during labour by bacteria introduced from without. This is, of course, greatly facilitated if premature rupture of the membranes should occur, although we know, from clinical observation, that bacterial infection, indicated by offensive odour, may take place through intact membranes. The liquor amnii may also be fouled by meconium passed *in utero* in conditions producing fœtal distress.

III. **The Forces of Labour.**—The propelling force consists of muscular contractions, aided possibly to an insignificant extent by gravity and by the elastic recoil of certain portions of the birth-canal. The most important muscle is the uterus; subsidiary to it are the diaphragm and the muscles of the abdominal wall; those of the arms, legs, and back lend a certain amount of assistance in the expulsive stages.

The Parturient Uterus.—The changes which the uterine muscle undergoes during pregnancy have been already described. At term the wall of the uterus is about one-third of an inch in thickness, and the organ measures 11½ to 12 inches (29 to 30 cm.) in length from os externum to fundus (cervix 1¼ to 2 inches—3·5 to 5 cm.); the diameters of the fundus itself are about 8 to 9 inches (20 to 22·5 cm.) transversely and 6 inches (15 cm.) antero-posteriorly. At the lower uterine segment the diameters are less, so that the organ is distinctly pyriform or ovoid in shape. The internal os is usually closed and the cervical canal intact when labour sets in (fig. 80). The parturient uterus acts by intermittent contractions, which are limited to the upper three-fourths of the body, and which have the effect, firstly, of dilating the lower uterine segment and cervix, and secondly, of expelling the uterine contents. The organ thus becomes differentiated during labour into an upper active and a lower passive section; this is probably an essential step in the process of parturition, and invariably precedes the actual expulsion of the fœtus.

The uterine contractions of labour are to be regarded as a development of the slight intermittent contractions which can be recognised clinically in the gravid uterus during the second half of pregnancy. During pregnancy the patient is unconscious of their presence, and they produce no effect upon either the cervix or the ovum; when labour begins they change their characters and become painful. Throughout the process they preserve their intermittent character, but the intervals tend gradually to diminish as labour advances, until the actual expulsion of the child through the vulva may be accomplished by a storm of powerful contractions separated by only slight intervals. After this their intensity suddenly falls, and the last part of the process—viz. the separation and expulsion of the after-birth—is accompanied only by a few feeble contractions. They are of course involuntary; in animals they are peristaltic, but clinically this is not observable in women. It may be surmised that the driving force of the uterus resides chiefly in the longitudinal fibres, contraction of which will tend to approximate fundus to cervix.

With each contraction a change in the shape and position of the uterus occurs. When at rest the organ lies moulded upon the vertebral column (fig. 93); during the contraction the fundus is thrown forward towards the abdominal wall, and the whole organ becomes rigid and erect. The effect of this change of position will be to make the long axis of the uterus correspond more closely to the line of the axis of the pelvic brim (fig. 94).

As labour advances two other important changes are brought about in the parturient uterus—viz. (1) *dilatation* of the lower uterine segment and cervix; (2) *retraction* of the uterine wall above this level. The exact nature of these changes has been the subject of acute controversy since the study of the anatomy of labour by frozen sections began, and even now unanimity of opinion has not been reached. In the following description the work of Barbour has been followed and his latest opinions adopted.

(1) *Lower Uterine Segment and Cervix.*—The condition of the cervical canal before labour commences has been already described; it measures from 1¼ to 2 inches (3·5 to 5 cm.)

from os externum to os internum and the lower uterine segment, corresponding to about the lower one-fourth of the total uterine cavity (Barbour), has the shape of a hemisphere. The condition of these parts at the end of the second stage of labour is shown in fig. 99.

The lower segment has been converted from a hemisphere into a cylinder, and now forms with the dilated cervix a single wide canal. The position of the os internum is very difficult to determine except by recognition of the upper limit of the characteristic cervical mucous membrane. But the conclusions arrived at by different observers upon this point are very divergent, and it appears probable that the proportion of the dilated part which corresponds to the cervix is variable.

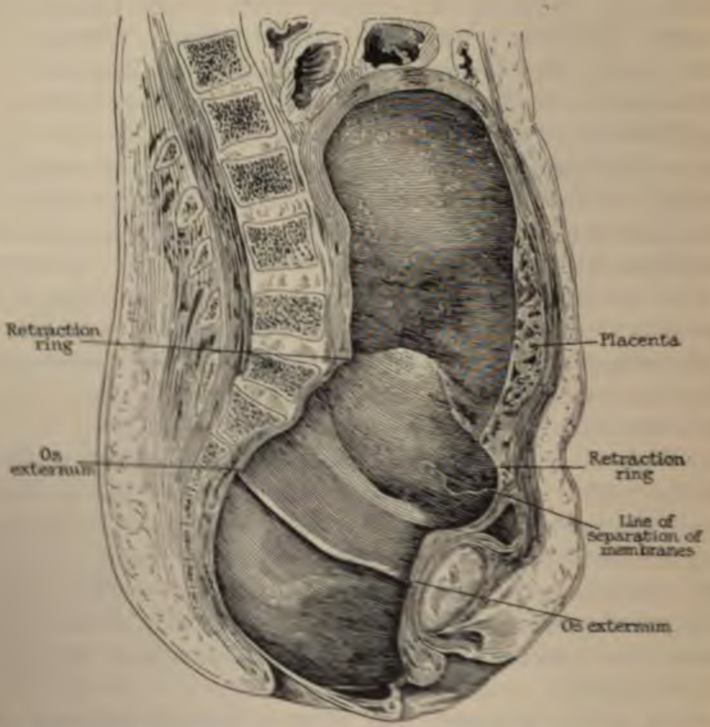

FIG. 99.—THE BIRTH-CANAL TOWARDS THE END OF THE SECOND STAGE OF NORMAL LABOUR. FROZEN SECTION FROM THE SAME SUBJECT AS FIG. 83 (BARBOUR.)

At the upper limit of this dilated part an abrupt change in the thickness of the uterine wall takes place, producing a raised ridge on the inner wall in the form of an irregular ring which varies a little in level in different parts. This ring is variously known as the *retraction ring* (Barbour), the *contraction ring* (Schroeder), *Bandl's ring*, *Barnes's ring*, &c. By some observers this ring was regarded as representing the internal os, the whole of the dilated part below it was considered to be cervix, and the existence of a lower uterine segment, distinct from the cervix, was denied. The work of Schroeder, Barbour, and Von Franqué, however, appeared until recently to have satisfied most observers that the upper portion of the dilated part comes from the uterine body, not from the cervix. But this view has now again been challenged by Bumm and Blumreich, so that it is evident that controversy upon the matter is not yet over.

The wall of the lower segment and cervix measures on an average one-tenth of an inch (25 mm.) in thickness, while above the lower segment the uterine wall varies from one-half to a-quarter of an inch (1·25 to 0·62 cm.) in thickness, being least at the placental site. Lower segment and cervix together now measure in length 3½ inches (9 cm.) on the anterior and 2½ inches (6·5 cm.) on the posterior wall. From examination of a number of frozen sections it appears that the average length of the uterus from fundus to os externum is 10 to 10½ inches (25 to 26 cm.) towards the end of the second stage of labour —*i.e.* before the expulsion of the fœtus. The total length of the uterus has therefore been reduced by about 1½ inch (4 cm.). The diameter of both lower segment and cervix is now about 4 inches (10 cm.). The *posterior vaginal wall* is greatly elongated—7 inches (18 cm.) in fig. 99—and somewhat thinned, while the anterior wall is practically unaltered in length.

(2) *The Retracting Uterine Wall.*—The line of abrupt transition from the lower segment to the uterine body above it represents the line of physiological differentiation of the uterus into an upper active and a lower passive zone. The uterine contractions occur in the active portion only, the *rôle* of the other being entirely passive, as is shown by the marked degree of dilatation and thinning which it has undergone. The reduction in length of the active portion and the

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if the cervix is artificially dilated, active contractions will be induced in the body of the uterus. This physiological relationship has been termed the *polarity* of the uterus. It has also been suggested that the longitudinal fibres of the outer muscular wall, when contracting, tend to pull the cervix upwards over the presenting part, and thus to some extent assist the process of dilatation.

Anything interfering with the normal mechanism, such as inefficient contractions, premature rupture of the membranes, or structural alterations in the cervix, will prevent or delay the occurrence of dilatation.

The Labour Centre.—It is possible that the process of parturition is under the control of a special centre in the lumbar enlargement of the spinal cord, for it is well known that in certain animals powerful uterine contractions can be induced by experimental stimulation of the lumbar enlargement. Also, women suffering from paraplegia due to injury or disease affecting the cord above the level of the lumbar enlargement may pass through an easy and rapid labour, which is, of course, painless. These facts, however, do not suffice to prove the existence of a labour centre; for large sympathetic ganglia are found at the sides of the uterus, between the layers of the broad ligament, which may, by automatic action, themselves induce contractions. Certainly in some animals rhythmic contractions of the uterine muscle may be induced by stimulating these ganglia, or the uterus may be made to contract after its removal from the body in the same manner. In the human subject, however, the balance of probability is in favour of the existence of a centre in the cord.

The manner in which the nerve centres, whether peripheral or spinal, are so excited as to initiate the process of labour is unknown. The onset of labour is no doubt due in some way to stimulation of these centres, and although many hypotheses have been advanced, the fact remains that there is little or no evidence in favour of any of them, and accordingly they need not be discussed. The progressive increase in the activity of these centres when once labour has commenced may be simply explained by peripheral stimuli coming from the uterine nerves, which are stretched by dilatation or compressed by muscular contraction.

General Effects of Labour.—During a uterine contraction it is noticed that the fœtal heart beats more slowly and more feebly, but quickly recovers its normal action as the pain passes off. The uterine souffle becomes louder at the commencement of a contraction, then rapidly diminishes, and becomes quite inaudible at the acme of the contraction. The mother's pulse is quickened during the contractions. The amount of blood lost during normal labour averages about ten ounces, more than half of which accompanies the placenta. The general effects of normal labour upon the mother are merely those of physical exhaustion; the temperature is seldom elevated more than one degree, and at the close the pulse is only quickened by some ten to fifteen beats above the normal. A trace of albumen is frequently found in the urine of perfectly healthy women during normal labour; this is especially common in primiparæ.

Anatomy and Physiology of the Third Stage of Labour

It has now been demonstrated by the study of frozen sections that separation of the placenta and the greater part of the membranes does not occur until the third stage (see fig. 99). At the beginning of this stage the uterus measures about 8 inches (20 cm.) vertically and 4 inches (10 cm.) antero-posteriorly; its wall is greatly thickened at all parts except the placental site. The uterine cavity is so reduced that the placenta practically fills it. The membranes are still attached to the uterine wall except in the lower segment, from which they are detached during the stage of dilatation, while the placenta is folded and much reduced in size. The plane of cleavage runs through the cavernous layer of the decidua basalis (fig. 12), the deepest part of which remains attached to the uterine wall.

It is, however, quite clear that in the great majority of cases the placenta is delivered in one of the following two ways: (1) In some instances a portion of the placenta near its centre becomes separated, and hæmorrhage from the torn uterine sinuses occurs at that spot. As more blood is effused an increase in the area of separation occurs by the formation of a retro-placental blood clot. The centre of the placenta is thus forced down towards the cervix, where its fœtal surface presents; it then passes through the aperture in the membranes formed by the passage of the fœtus, and enters the vagina, pulling the membranes off behind it and turning them inside out (fig. 100). This mode of separation, which can frequently be observed, was first described by Schultze. (2) The second mode of separation of the placenta is illustrated in fig. 101. Detachment commences at the lower pole, which is not subjected to the same amount of compression as the remainder of the placenta, and the whole organ is gradually forced into the cervix, the upper pole being the last to leave the uterine cavity. The uterine surface of the placenta presents in this case.

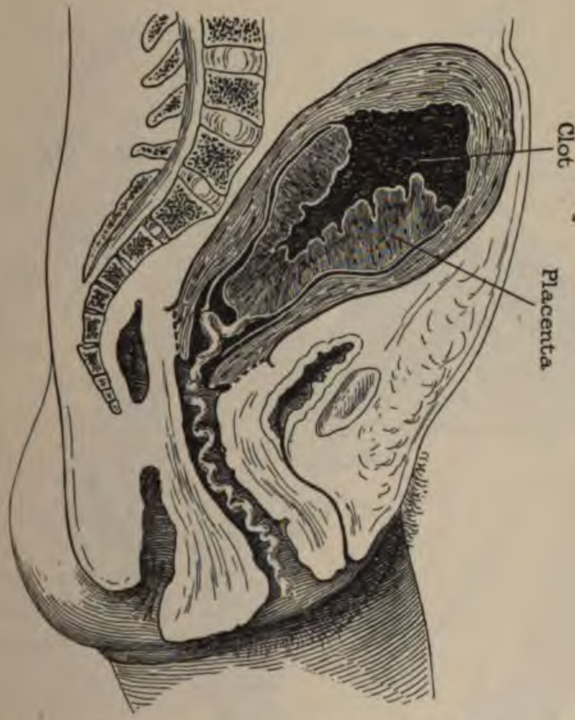


FIG. 100.—SEPARATION OF THE PLACENTA BY FORMATION OF RETRO-PLACENTAL CLOT. (VARNIER.)

The mechanism of the latter mode of separation has been explained by Barbour as follows: When retraction occurs after the expulsion of the child, the area of the uterine surface is much diminished; the placenta, being an inelastic organ, cannot follow this diminution to any great extent, and therefore becomes detached, the uterine wall tearing itself away from the placenta. This process begins at the lower pole, because there the edge is entirely unsupported. Separation, once commenced, is advanced by each recurring contraction, and hæmorrhage plays no part in this mechanism. In the case

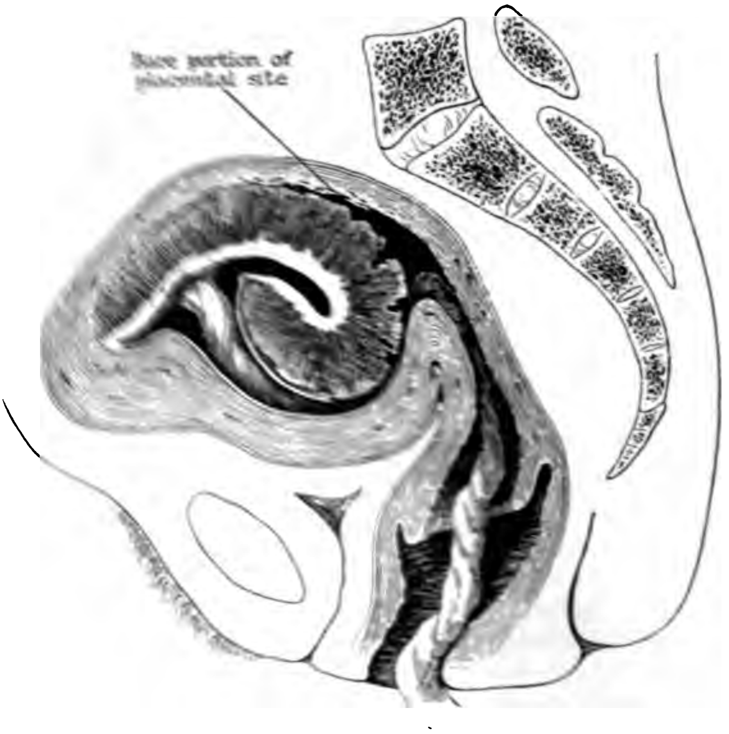


FIG. 101.—SEPARATION OF THE PLACENTA FROM BELOW UPWARDS. (BUMM.)

of the first-mentioned mode of separation, on the other hand, relaxation of the uterus at the placental site, leading to effusion of blood, is probably the initial factor in its production. This mode of separation will therefore be met with when retraction in the third stage is inadequate. It has been suggested that in cases of fundal insertion of the [illegible]nta, the same result may occur without hæmorrhage; [illegible]ntral portion of the placenta, being then unsupported, becomes first detached by retraction and then driven downwards by contractions, thus causing the fœtal surface to present in the cervix.

The separated placenta is expelled through the cervix, vagina, and vulva mainly by the action of the accessory muscles; uterine contractions are at this stage too feeble to play any important part in the process of expulsion.

The Mechanism of Normal Labour

In this section will be described the effects produced by the expulsive forces upon the ovum, and the manner in which the process of expulsion is accomplished.

First and Second Stages.—It will be understood that during the greater part of the process of labour the uterine contractions do not act directly upon the body of the fœtus, for the latter is completely protected by the amniotic fluid. Pressure is transmitted to the fœtus only through this fluid covering, and since pressure is transmitted by a fluid medium equally in all directions, the effect must be mainly of the nature of general compression by increase of intra-uterine tension (*general or indirect intra-uterine pressure*) (fig. 102). In this way an expulsive action will, however, be exerted upon the complete ovum (membranes unruptured), causing it to protrude through the dilating cervix, and in some cases an

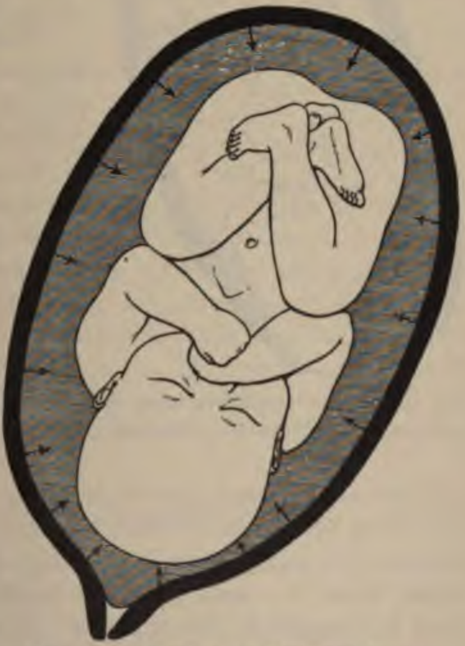


FIG. 102.—GENERAL OR INDIRECT INTRA-UTERINE PRESSURE. (DAKIN.)

The arrows indicate the direction of the force exerted by the contracting uterus.

unruptured ovum may be thus completely expelled from the uterus; but here the expulsive forces never act directly upon the body of the fœtus at all. While the membranes remain intact, or when sufficient liquor amnii is retained, it follows that no effects injurious to the fœtus can be produced. The direction of the advance at this stage must be that of least resistance viz. through the expanding cervix. This direction will be represented by a line drawn at right-angles to the plane of the internal os—the *axis of the internal os.* When the uterus is made erect by contraction, and there is only slight lateral obliquity, the axis of the uterus and the axis of the internal os are practically identical, and correspond with the axis of the pelvic brim.

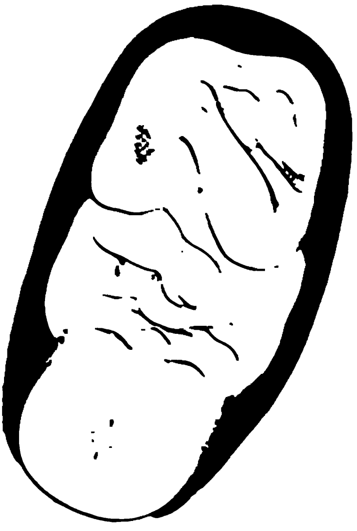


FIG. 103.—DIRECT INTRA-UTERINE OR FŒTAL AXIS PRESSURE [illegible]

When the membranes have ruptured and the greater part of the liquor amnii has escaped—*i.e.* towards the end of the second stage of labour—the contracting uterine wall comes down upon the body of the fœtus, exerting pressure directly upon it (*direct intra-uterine pressure*) (fig. 103). The driving force now acts upon the breech, and the line of advance will be the line of the fœtal axis; this corresponds under normal conditions to the axis of the pelvic inlet. The term *fœtal axis pressure* is often applied to the uterine force at this stage. Force thus exerted upon the trunk of the fœtus, when the head is in the pelvic cavity, will cause the head to advance in the direction of that part of the pelvic axis to which it corresponds at the time. It will be clear that prolonged pressure in these circumstances may produce injurious effects through direct compression of the body of the fœtus, the placenta, or the cord.

In normal labour the progress of the fœtus through the [illegible]-canal is watched by observing the advance of the fœtal head; the relation of the head to the pelvic brim at the commencement of labour is therefore of great importance. It has already been stated that the vertex presents in 96 per cent. of all labours. This predominant frequency is due to two causes: (1) under normal conditions the fœtal ovoid adapts itself best to the shape of the uterus when the head lies below, the breech above; (2) the centre of gravity of the fœtus lies nearer the head than the breech, therefore the fœtus will, if undisturbed, float in the liquor amnii with the head below.

With the vertex presenting, the fœtus may occupy four different *positions*: the back may be anterior and directed either to the left or right of the mother; or the back may be posterior and directed either to the right or left of the mother. The part of the vertex which corresponds with and indicates the position of the back is, of course, the occiput; this is termed the *denominator* of the positions which are named from it thus (figs. 104–107):

1st position	Left occipito-anterior	L.O.A.
2nd "	Right occipito-anterior	R.O.A.
3rd "	Right occipito-posterior	R.O.P.
4th "	Left occipito-posterior	L.O.P.

The term *position* thus indicates the relation of the back of the fœtus to the mother, and it will be found that in all presentations the four positions correspond (see p. 243). In the first and third positions the diameter of engagement of the head roughly corresponds with the right oblique diameter of the pelvic brim; in the second and fourth positions it corresponds with the left oblique.

The frequency of the various *positions* of the vertex may be stated as follows:

1st position	74%	Right oblique diameter	94%
2nd "	5%		
3rd "	20%		
4th "	1%	Left " "	6%

From this it will be seen that the vertex engages in the right oblique diameter about sixteen times oftener than in the left; this is mainly due to the fact that the left oblique is encroached upon by the presence of the sigmoid flexure and rectum, and therefore does not accommodate the head so well as its fellow. Again, the first position is three to four times

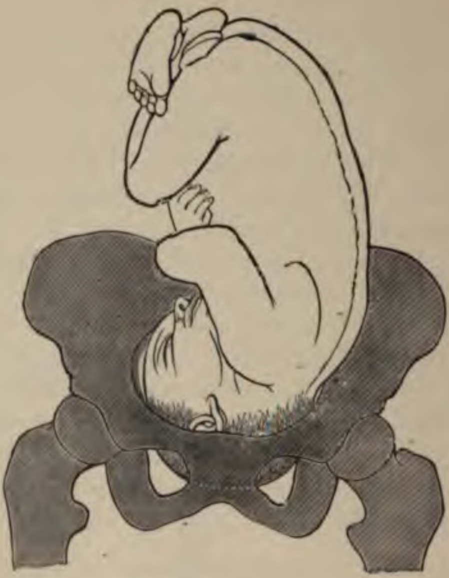


FIG. 104.—VERTEX PRESENTATION. FIRST POSITION (L.O.A.).
(FARABŒUF AND VARNIER.)

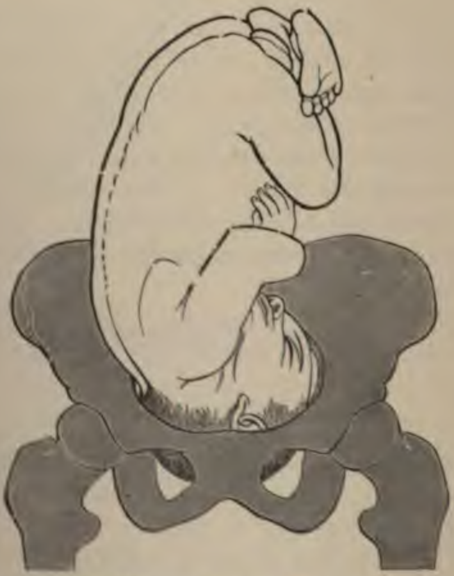


FIG. 105.—VERTEX PRESENTATION. SECOND POSITION (R.O.A.).
(FARABŒUF AND VARNIER.)

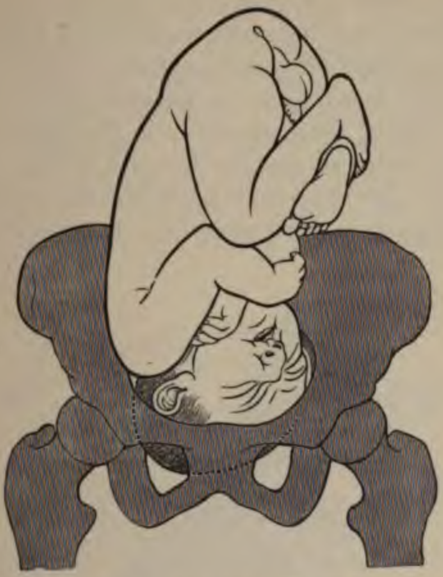


FIG. 106.—VERTEX PRESENTATION. THIRD POSITION (R.O.P.).
(FARABŒUF AND VARNIER.)

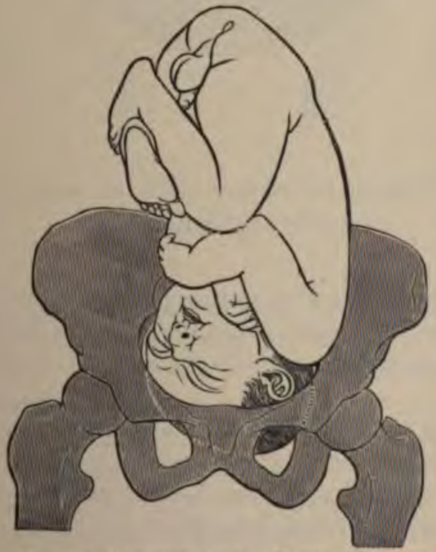


FIG. 107.—VERTEX PRESENTATION. FOURTH POSITION (L.O.P.).
(FARABŒUF AND VARNIER.)

more frequent than the third; this is to be accounted for by the fact that the fœtus lies more easily in the uterus when the back is anterior than when it is posterior. In the latter the convexity of the fœtal spine is opposed to the convexity of the maternal lumbar vertebræ, while in the former the ventral aspect of the fœtus adapts itself easily to the curve of the spinal column. In the fourth position—the rarest—the conditions are the least favourable - viz. engagement in the left oblique diameter, and posterior position of the back. As we shall see, the posterior position of the back is also apt to cause some disturbance of the normal fœtal attitude of flexion.

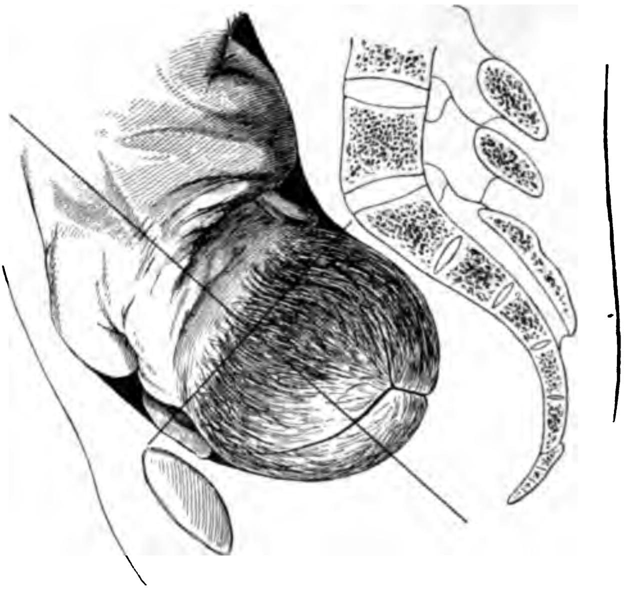


FIG. 108.—ANTERIOR ASYNCLITISM; NÄGELE'S OBLIQUITY. (BUMM.)

The trunk lies away from the maternal spine.

The study of frozen sections has proved that when the vertex engages in the pelvic brim, owing to the lateral inclination of the head and to other causes, one parietal bone frequently lies at a lower level than the other (fig. 108); as a result the sagittal suture does not correspond precisely to the oblique diameter of the brim, but lies either in front of or behind it. This is known as *asynclitism*. Usually the head inclines to the posterior shoulder, the anterior parietal bone is below the posterior, and the sagittal suture lies nearer the promontory than the symphysis (*anterior asynclitism* or *Nägele's obliquity*); sometimes, however, the sagittal suture lies nearer the symphysis than the promontory (*posterior asynclitism*). The former is found chiefly in multiparæ, the latter in primiparæ, the reason being that in primiparæ the relatively tense abdominal walls tend to keep the uterus back and so prevent the body of the fœtus from coming forward into the line of the axis of the brim; accordingly, when the head enters the brim the posterior parietal bone is lower than the anterior (figs. 108 and 109). Sectional anatomy has shown that in some cases (about 25 per cent.) this lateral inclination is absent, and the sagittal suture corresponds to the oblique diameter of the pelvis. It is probable that under normal conditions asynclitism is corrected very early in labour.

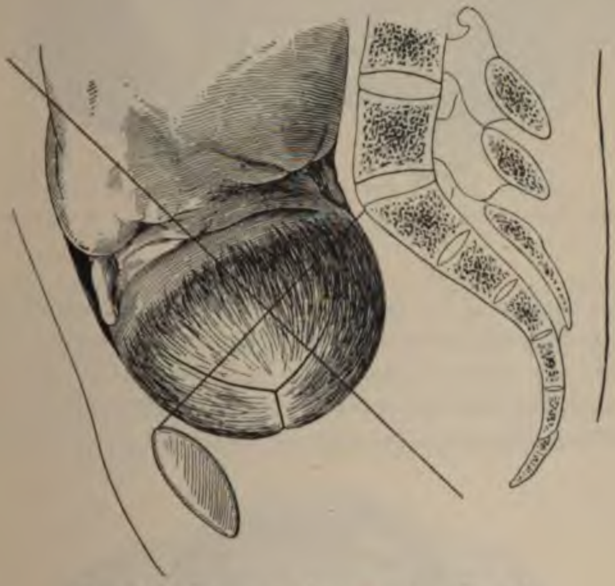
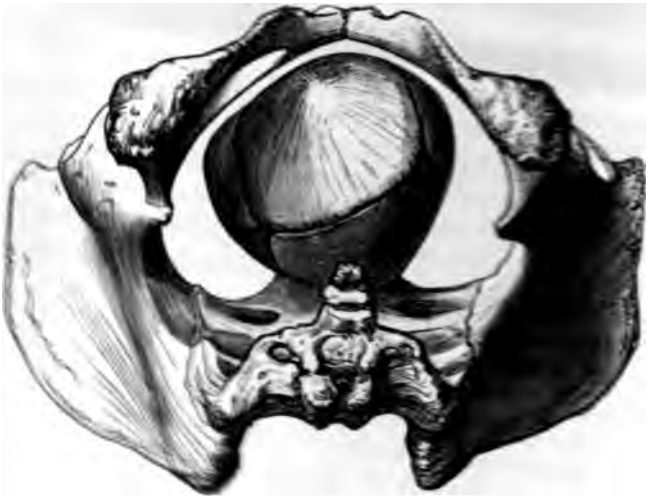


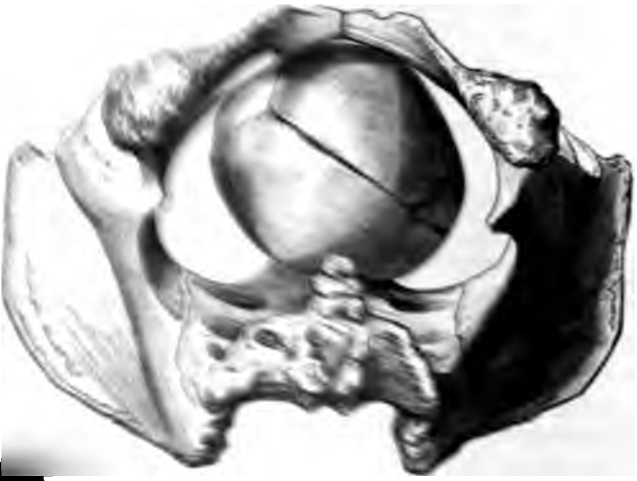
FIG. 109.—POSTERIOR ASYNCLITISM. (BUMM.)

The trunk lies close to the maternal spine.



[illegible] Position of the Vertex (L.O.A.), Anterior Asynclitism.

[illegible] head to the pelvis at the onset of labour [illegible] the vertex as it appears when viewed [illegible] shown in figs. 110 to 113. It will be [illegible] suture roughly corresponds to one of [illegible] may lie a little in front or behind



[illegible] 11.—Second Position of the Vertex (R.O.A.), Posterior Asynclitism.

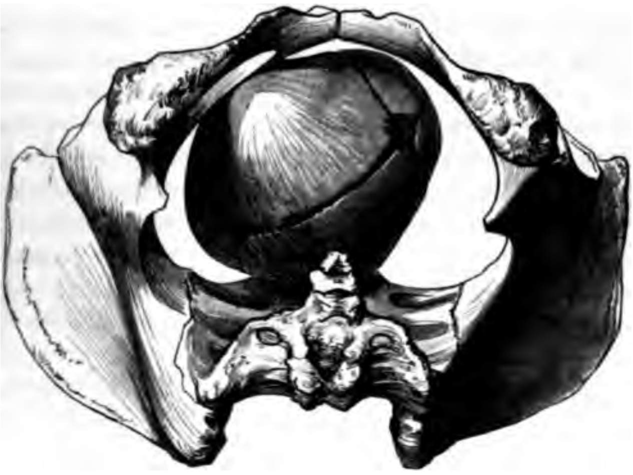


FIG. 112.—THIRD POSITION OF THE VERTEX (R.O.P.). HEAD FAIRLY WELL FLEXED.

as asynclitism is more or less pronounced. At one end of
e suture lies the anterior fontanelle, at the other end the
sterior fontanelle. If the head is well flexed, the posterior
ntanelle is lower than the anterior; if the head is im-
rfectly flexed, this will not be the case. These points will
ain arise in connection with the diagnosis of position (p. 229).

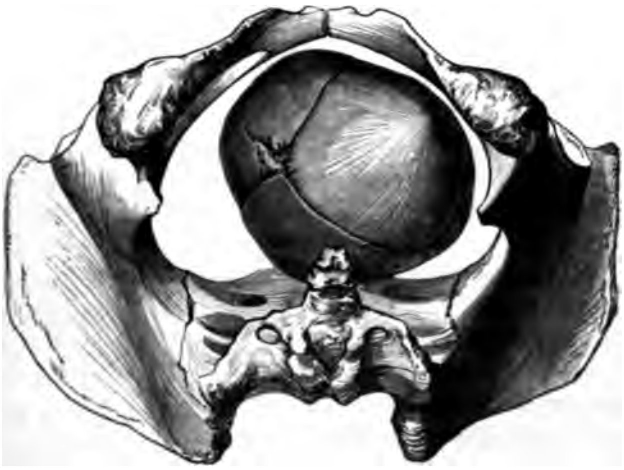


FIG. 113.—FOURTH POSITION OF THE VERTEX (L.O.P.). ANTERIOR ASYNCLITISM. INCOMPLETE FLEXION.

by causing the head to move upon the occipito-atloid articulation. If the obliquity of the uterus should be left instead of right, then extension would be promoted instead of flexion, the uterine force acting more powerfully upon the sinciput. It is probable, however, that little importance can be attached to this mechanism under normal conditions, for when the uterus contracts it tends to become erect, thus diminishing its lateral obliquity; the position it occupies when at rest can have no effect upon the advance of the head.

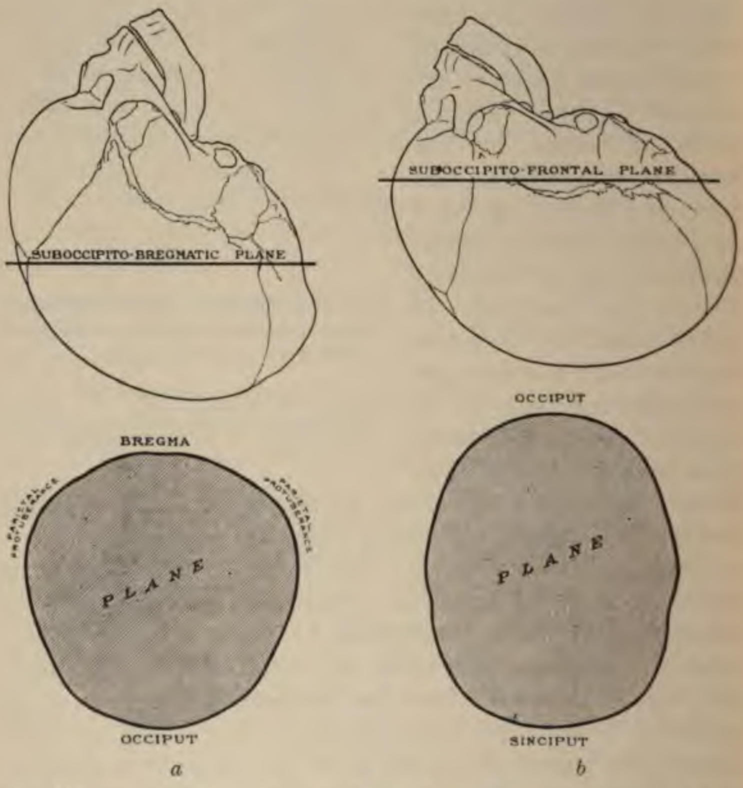


Fig. 115.—*a*, The Position and Shape of the Sub-occipito-bregmatic Plane of the Fœtal Head. *b*. The Position and Shape of the Sub-occipito-frontal Plane of the Fœtal Head. (Edgar.)

It must be recollected that when flexion is deficient the diameter of engagement is longer than when it is complete, and the difficulties attending the passage of the head are greater. When the head is flexed to the greatest possible extent, the sub-occipito-bregmatic diameter engages. The shape of the head in the plane of this diameter is shown in fig. 115, *a*; its dimensions are well within those of the pelvic brim or cavity. When the head is less fully flexed the sub-occipito-frontal diameter becomes engaged; the shape and size of the plane of this diameter are shown in fig. 115, *b*. This plane is approximately quadrilateral, and is therefore not so well adapted to pass easily through the pelvis, while its dimensions are of course greater than those of the sub-occipito-bregmatic plane. When the head is midway between flexion and extension, the occipito-frontal diameter engages, and the plane of this diameter has the same shape, but is of even larger size than the sub-occipito-frontal (fig. 116). It will therefore be apparent that complete flexion of the head is of great mechanical advantage in a vertex presentation, since in this position the plane of engagement is not only the smallest possible, but also of a shape which will readily pass through the pelvic canal. It is, however, probable that at the beginning of labour the head usually engages in the sub-occipito-frontal plane, or in a plane intermediate between this and the sub-occipito-bregmatic (see fig. 104), and if the dimensions of the head and the pelvis are normal, it may pass through without any marked increase of flexion being produced.

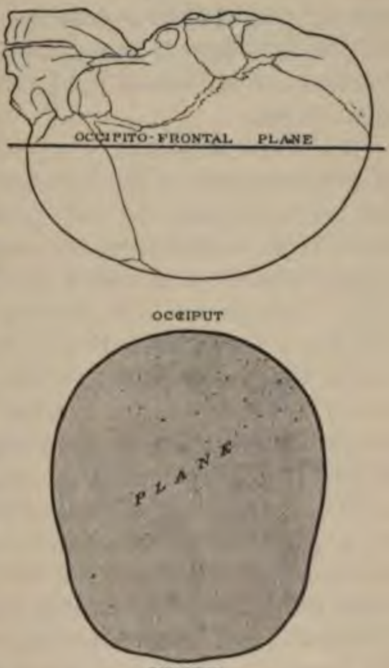


FIG. 116.—THE POSITION AND SHAPE OF THE OCCIPITO-FRONTAL PLANE. (EDGAR.)

II. *Internal Rotation.*—The head enters the pelvic brim, as we have seen, approximately in the oblique diameter; internal rotation is a movement which carries the head into the antero-posterior diameter of the pelvic outlet. The advantage gained by this movement is that the diameter of engagement is brought into the longest diameter of the pelvic outlet, for when the vertex is extended the antero-posterior measures about five and a-quarter inches. In the first and second positions internal rotation almost always brings the occiput forwards under the pubic arch; in the third and fourth positions the same thing usually occurs; but sometimes, from causes which will be mentioned later, the occiput rotates backwards into the sacral hollow while the sinciput comes to the front. In the first and fourth positions the direction of forward rotation is from left to right; in the second and third from right to left.

[illegible] of the [illegible].—The essential cause of this movement is the influence of the *sloping pelvic floor.* As we have seen, the soft parts forming the pelvic floor slope from behind forwards and downwards, and from the sides inwards, downwards, and forwards—towards the middle line. Therefore a body coming in contact with any part of the floor must be directed by it forwards and downwards under the pubic arch. When the head is flexed the posterior part of the vertex reaches the pelvic floor in advance of the sinciput, and is accordingly directed forwards by its slope [illegible] until the occiput comes under the pubic arch. This will occur whether the occiput lies in an anterior or a posterior position. Since the pelvic floor is deficient anteriorly, corresponding to the wide pubic arch, the part of the head which moves forwards is moving in the direction of least resistance, and there is nothing to oppose it. The movement of forward rotation is much larger in the case of posterior than anterior positions of the vertex, the difference being approximately equal to a quarter of a circle.

[illegible] of a woman who died during the second stage [illegible] shows the movement of internal rotation in progress, the occiput coming forwards, while dilatation of the vulva has begun.

Backward [illegible] of the Occiput.—If, in an occipito-posterior position, the head is extended so as to bring the occipito-frontal diameter into the pelvic brim, the anterior end of the vertex will form its lowest part (fig. 116). When this part reaches the pelvic floor it will be directed downwards and forwards under the pubic arch, and the occiput will consequently pass backwards into the sacral hollow. The primary cause of backward rotation is therefore extension of the vertex. While it is extremely rare in anterior positions, extension is not uncommon in posterior positions, and is amply accounted for by two considerations: (1) In posterior positions the general attitude of flexion is often disturbed by some degree of extension of the spine which results from the opposition of the two convexities of the fœtal back and the maternal lumbar vertebræ; if the fœtal spine becomes extended the fœtal head will become extended also. This implies that some degree of extension is present at the commencement of labour. (2) Extension may be produced or increased during labour by the unfavourable position in which the head is placed (fig. 117). The widest part of the fœtal head lies behind its centre and corresponds to the bi-parietal diameter. In a posterior position this diameter lies behind the oblique diameter of the brim, between the sacral promontory and the ilio-pectineal eminence—a position where space is limited, and it therefore meets with opposition to its descent. The narrow sincipital end, on the other hand, lies in the widest part of the pelvis where it can descend easily; consequently the head becomes extended.

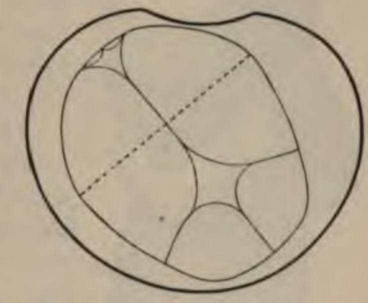


FIG. 117.—OCCIPITO-POSTERIOR POSITION OF THE VERTEX. (HERMAN.)
The dotted line indicates the bi-parietal diameter.

Another possible factor in the production of backward rotation may also be mentioned. If the vertex is so extended as to make the occipito-frontal the diameter of engagement, the length of the transverse diameter of the pelvic cavity will form a mechanical obstacle to forward rotation of the occiput. This diameter measures four and a-half inches—*i.e.* about the same as the occipito-frontal; yet, if forward rotation occurs, the head must pass through this diameter before the occiput can reach the pubic arch. It will clearly be easier for the occiput to pass backwards, thus bringing the diameter of engagement immediately into the long diameter of the outlet.

If the vertex is flexed, no difficulty will be occasioned in forward rotation by the length of the transverse diameter. In the case of certain varieties of contracted pelvis the *inclined planes of the ischium* control the movement of internal rotation, but for the reasons stated on page 300 they are probably inoperative in normal labour.

It will be understood from what has been said that, while backward rotation may exceptionally occur in anterior positions, this occurrence is extremely rare and can only be rendered possible by marked extension of the head. In posterior positions it occurs in about one case in ten. When backward rotation occurs the condition is called a *persistent occipito-posterior* or *face-to-pubes case*.

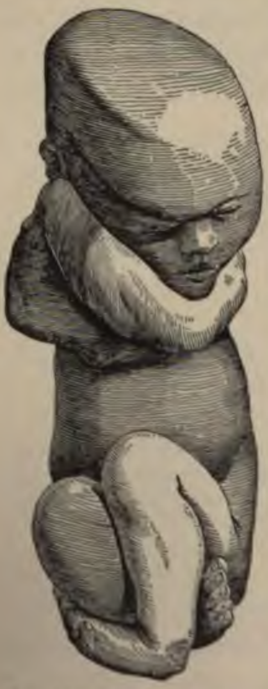


FIG. 118.—FŒTUS FROM A FROZEN SECTION OF A WOMAN WHO DIED IN LABOUR TOWARDS THE END OF THE SECOND STAGE; SHOWING EXTENSION OF THE TRUNK. (BARBOUR.)

III. *Extension.*—After internal rotation has been completed the head emerges at the vulva, the occiput coming first, then, successively, the vertex, forehead, and face. When the chin slides over the edge of the perineum, it of course becomes separated from the chest-wall—*i.e.* the head becomes extended. It is probable, however, that extension begins earlier than this, and is in fact part of a general change in the attitude of the fœtus which takes place towards the end of the second stage. The fœtus shown in fig. 118 is the same as that seen *in utero* in fig. 83. When carefully examined it will be noticed that flexion of the trunk is not nearly so marked as in the fœtus before the onset of labour (fig. 95), this change being indicated by the considerable interval which here exists between the folded arms and the knees. The chin is also no longer in contact with the chest. In other words, extension has already begun; it is probably a normal occurrence at this stage of labour. Complete extension of the head only occurs, however, in the actual process of expulsion through the vulva.

IV. *Restitution and External Rotation.*—These are movements of the neck and trunk, the head being merely the index. (1) *Restitution.*—While the head is emerging in the antero-posterior diameter of the outlet, the shoulders engage in the oblique diameter of the brim. In this attitude there is slight torsion of the neck, and when the head is free a slight movement occurs, bringing it into its normal relation to the bis-acromial diameter. In first and fourth vertex positions this movement is represented by a slight turn of the occiput to the mother's left; in second and third to the mother's right.

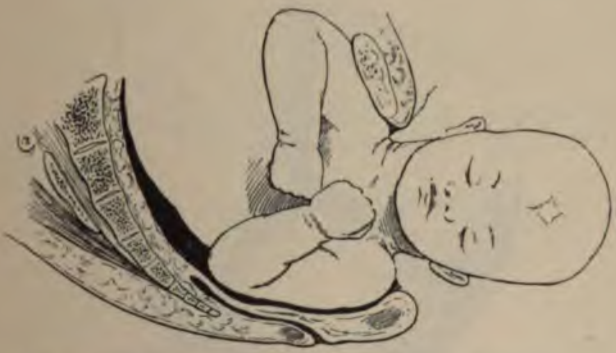


FIG. 119.—EXPULSION OF THE SHOULDERS IN THE ANTERO-POSTERIOR DIAMETER OF THE OUTLET; MOVEMENT OF EXTERNAL ROTATION COMPLETE. (DAKIN.)

(2) *External Rotation* represents the movement of the shoulders from the oblique diameter of the brim to the antero-posterior diameter of the outlet, in which they are born. The anterior shoulder rotates forwards under the pubic arch, and in first vertex positions this movement carries the occiput still further round to the mother's left, so that the face is now directed to the right thigh (fig. 119). External rotation is thus a continuation of the movement of restitution.

It is unnecessary to describe separately the movements of the head in all four positions of the vertex. Posterior positions differ from anterior chiefly in their liability to be associated with deficient flexion and in the variation of the movement of internal rotation which is thus brought about. As regards internal rotation, the conditions which induce forward or backward rotation have been indicated. In the movements of restitution and external rotation, the occiput always moves to the side where it lay at the commencement of labour.

Effect of Labour upon the Fœtal Head.—The pressure to which the head is subjected during labour occasions certain alterations in the relations of the movable bones of the vault of the skull to one another; these changes are termed *moulding* of the head. The tabular portion of the occipital

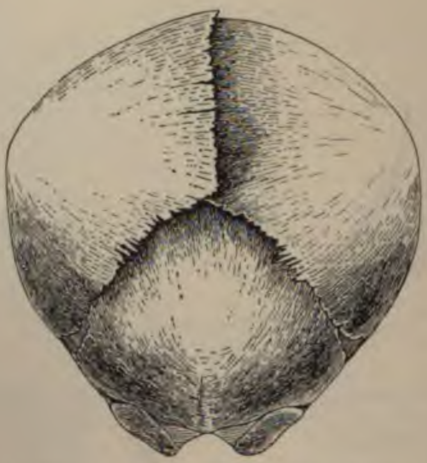


FIG. 120.—HEAD MOULDING, SHOWING OVERLAPPING OF BONES AT THE LAMBDOIDAL AND SAGITTAL SUTURES. (RIBEMONT-DESSAIGNES AND LEPAGE).

bone becomes depressed so as to deepen the posterior fontanelle, while the edge of the bone slides under the posterior edges of the parietal bones (fig. 120). The same change occurs, but to a less marked extent, at the sagittal suture; one or other parietal bone becomes slightly depressed beneath its fellow along the sagittal suture. The general effect of these changes is also seen in an altered shape of the fœtal head; the ressure of the girdle of contact is applied in the plane of e sub-occipito-bregmatic or sub-occipito-frontal diameters; plane therefore becomes somewhat compressed, while pensatory elongation occurs in the plane at right-angles —*i.e.* the occipito-mental plane. The head consequently

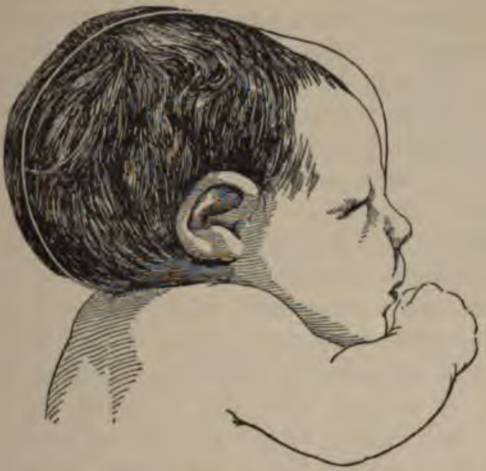


FIG. 121.—SLIGHT MOULDING OF THE FŒTAL HEAD IN VERTEX PRESENTATION, WITH SMALL CAPUT ABOUT THE MIDDLE OF THE RIGHT PARIETAL BONE. (BUMM.)

The linear outline represents the shape of the head before labour.

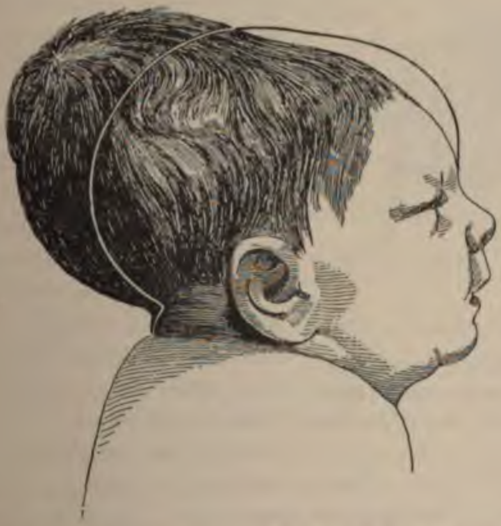


FIG. 122.—EXTREME MOULDING OF THE FŒTAL HEAD IN VERTEX PRESENTATION, WITH LARGE CAPUT ON THE POSTERIOR PART OF THE RIGHT PARIETAL BONE. (BUMM.)

becomes lengthened in its occipito-mental diameter (occipital tuberosity to point of chin) and shortened in its sub-occipito-frontal diameter (fig. 121). The effect of moulding in occipito-posterior positions is described on page 240. The degree of moulding met with is proportional to the pressure to which the head is subjected during labour; in the case of an over-sized head or an undersized pelvis extreme moulding of this type may occur (fig. 122).

The pressure of the girdle of contact upon the head also indirectly produces changes in the scalp. As the head is driven down, and the passages dilate, the part of the scalp lying in the centre of the birth-canal is free from pressure, while the part immediately above and around it is firmly compressed by contact with the maternal tissues. From interference with venous return effusion of serous fluid into the subcutaneous cellular tissue takes place upon the exposed area of the scalp, forming a swelling known as the *caput succedaneum*. It is clear that this change will occur at the end of the first and during the second stages of labour; it is seldom met with until after the membranes have ruptured. In the *first position* of the vertex the right parietal bone lies in front of and below the left, and, owing to the flexed position of the head, the posterior end of the bone lies at a lower level than the anterior. The exposed area therefore corresponds to the posterior end of the right parietal bone, close to the sagittal suture (fig. 123), and in this position the *caput* usually forms. The size of the caput is proportional to the degree of compression—which again depends upon the relation in size of the head and the pelvis—and to the length of time which elapses between rupture of the membranes and expulsion of the head. The presence of a large caput upon the nborn head is therefore an important sign of obstruction in our. The side of the head upon which the caput is formed ends upon *position*; its exact place upon the parietal bone

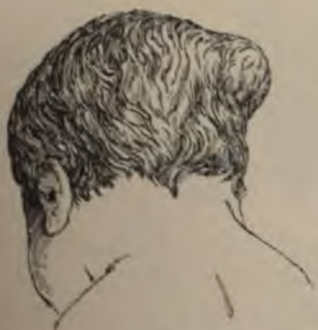


Fig. 123.—Caput succedaneum; First Vertex Position. (Ribemont-Dessaignes and Lepage.)

depends upon the degree of *flexion* of the head. In first and fourth positions it is on the right parietal; in second and third positions upon the left; when the head is fully flexed it is placed far back, close to or overlapping the posterior fontanelle; when the head is incompletely flexed it will be found more anterior, and may even be near the anterior fontanelle. The usual location of the caput is therefore as follows:

1st position	Posterior end of right parietal
2nd ,,	Posterior end of left parietal
3rd ,,	Middle or front of left parietal
4th ,,	Middle or front of right parietal

But if in third and fourth positions the head is well flexed, the *caput* will be formed nearer the posterior part of the bone.

If after internal rotation has occurred the head is long delayed on the pelvic floor, a *caput* will form upon the part of the scalp which presents at the vulva—*i.e.* the region of the occipital bone near the posterior fontanelle. This is sometimes called the *secondary* caput succedaneum; its place is the same in all positions of the vertex when forward rotation of the occiput occurs; it will be found upon the sinciput in face-to-pubes cases.

It will be seen that the position of the *caput* and the nature of the moulding are useful indications of the position occupied by the head in the pelvic cavity. They must be noted immediately after birth, as moulding often disappears in a few hours, and the caput is always absorbed in from twenty-four to forty-eight hours.

The Management of Normal Labour

In this section will be considered (I.) antiseptics; (II.) diagnosis; (III.) management.

I. **Antiseptics.**—Every case of labour must be conducted with the most scrupulous attention to surgical cleanliness on the part of all who are in attendance upon the patient. Puerperal infection is due in the great majority of instances to the introduction of pathogenic organisms into the genital canal; there may be a few exceptions to this rule, but they do not impair its general force. Under ordinary circumstances surgical cleanliness in obstetric work cannot be attained without the free use of antiseptics; it is probable that 'aseptic' disinfect the vulva as for a surgical operation, but this would be misunderstood and resented in private practice. In every case the vulva should be first well cleansed with soap and water, then with fresh water, and finally thoroughly swabbed with an antiseptic solution ; for this purpose carbolic acid (1 in 40) or one of the coal-tar products such as lysol or izal (1 in 160—*i.e.* ʒj. to Oj.) is preferable to mercurial solutions, for frequent swabbing is required during labour, and the mercurial solutions when freely used cause a good deal of irritation of the mucous surfaces. Only perfectly clean and fresh linen, or clean pads of absorbent wool, should be allowed, after the external genitals have been disinfected, to come in contact with them. The *hands* and *forearms* of the medical attendant and the nurse should first be scrubbed for five minutes in hot water and soap with a *boiled* nail-brush ; then the soap rinsed off in fresh hot water, and the hands finally immersed for two to three minutes in a solution of 1–1,000 biniodide or perchloride of mercury. It is almost superfluous to point out that it is impossible to sterilise the hands without first removing the coat, turning the shirt-sleeves up above the elbows, and removing rings from the fingers. If the hands have recently been infected from contact with a septic midwifery case or a suppurating wound, especial care must be taken, for it is well known that skin actually infected with pathogenic organisms is extremely difficult to sterilise, and the usual process should be repeated two or three times to ensure safety. Under these circumstances the use of rubber gloves, previously boiled for ten minutes, forms an additional safeguard which should never be omitted. If the precautions mentioned above are taken, the routine use of rubber gloves in all cases is unnecessary, and their cost forms an obstacle to their general adoption in all classes of midwifery practice. But in the cases of patients suffering from infectious discharges, whether of specific or septic origin, sterilised gloves should be worn not alone in the patient's interest, but also to protect the hands of the attendant from infection, and thus render it practicable for him to attend other cases with safety.

It must be remembered that clothing also becomes infected by contact with septic discharges, and possibly also by exposure to the atmosphere of an ill-ventilated room in which a septic case is lying. Therefore, in the case of an obstetric nurse who has attended a septic case, the disinfection of her clothing becomes a matter of the greatest importance, and it is the duty of the medical man under whom she works to see that these precautions are carried out. All washable articles should be boiled; others should be sent to the local sanitary authority, by whom they will be efficiently disinfected by heat. What is requisite for the nurse is also requisite for the medical attendant, although the danger in his case is less because he is not exposed to the risk of contact with septic material for such a long period as the nurse. A complete change of clothing and repeated disinfection of the hands are, however, absolutely necessary before passing from a case of infectious fever, of puerperal or surgical infection, or of suppuration of any kind, to one of normal labour. If these precautions are taken, it is not necessary for the medical attendant or the nurse to be suspended from obstetric work for a longer period than is required for the due performance of the various steps in disinfection; mere abstinence from work and lapse of time (although the latter may diminish the virulence of organisms deposited upon skin or clothing) are not disinfecting agents; they cannot be relied upon alone, and if other methods are efficiently practised they are unnecessary.

In making a vaginal examination of a parturient or lying-in woman, the medical attendant should first disinfect his own hands and then the vulva of the patient, if no nurse is present to do this. The hands are then again immersed in the antiseptic solution, and, while the fingers of the left hand separate the labia, the index and middle fingers of the right hand are carefully passed into the vagina, avoiding all contact with the vulval hair, the patient's clothing, or bed-clothes. In making the examination the hands should be used dripping wet with the antiseptic solution; no unguent is necessary, for the wet fingers will not cause the patient the least discomfort, and it is well known that the so-called antiseptic unguents possess no bactericidal properties, and may even be a source of danger, for in some of them bacteria in a living state may exist for a long time. When it is necessary to repeat the examination the hands must again be disinfected, and the vulva swabbed with the antiseptic solution.

Of the many antiseptic substances employed in surgery, there is a general consensus of opinion that the mercurial salts are the most reliable for the disinfection of the skin. Biniodide is preferable to perchloride of mercury, because it is a slightly more powerful germicide, does not roughen the skin when frequently used, and does not coagulate albumen, nor corrode steel instruments. The bactericidal action of a solution of biniodide of mercury is increased by an admixture of alcohol in the proportion of three parts of water to one of methylated spirit. Rubber, glass, or metal instruments should all be sterilised by boiling.

The question of vaginal douching will be most conveniently considered when dealing with the puerperium (p. 400), but it may be stated here that douching is unnecessary before or during labour in a normal case when the vaginal canal is healthy. When the membranes rupture, and again when the body of the child escapes, the passages are flushed from above with a large quantity of sterile fluid (the liquor amnii), which serves all the mechanical purposes of a douche and has none of its attendant risks. Sometimes the amniotic sac becomes infected during labour, usually after, but sometimes before, rupture of the membranes, and then of course this advantage is lost, and if the condition is recognised douching should be employed. The presence of a purulent or muco-purulent vaginal discharge also indicates the necessity for careful douching during labour; the best antiseptics under such circumstances are lysol 1–240 or biniodide of mercury 1–4,000.

II. **Diagnosis.**—The first examination of a woman in labour should be directed to the recognition of the three following points, which are of great practical importance: (1) the presentation and position; (2) the relation between the size of the fœtal head and that of the pelvis; (3) the presence of the fœtal heart-sounds. These matters must be settled at the beginning of labour, and accordingly the examination should be made as early in labour as possible, unless the medical attendant has taken the precaution, advised on page 72, of making the diagnosis of these points during the latter weeks of pregnancy. Only by this method can causes of obstruction be recognised in time to avoid the serious maternal and fœtal dangers to which they give rise when their presence is not detected until labour is advanced. Both abdominal and vaginal examination will be required.

Abdominal Palpation.—Nearly all the information required at this stage can be obtained by examination of the abdomen ; no risk or discomfort to the patient is involved in it, and it may accordingly be freely employed. A certain amount of skill, which can only be attained by practice, is required, and the details of palpation are much more readily learned during pregnancy, when the uterus is quiet, than during labour, when it is actively contracting ; the student should therefore miss no opportunity of practising this method during the latter weeks of pregnancy.

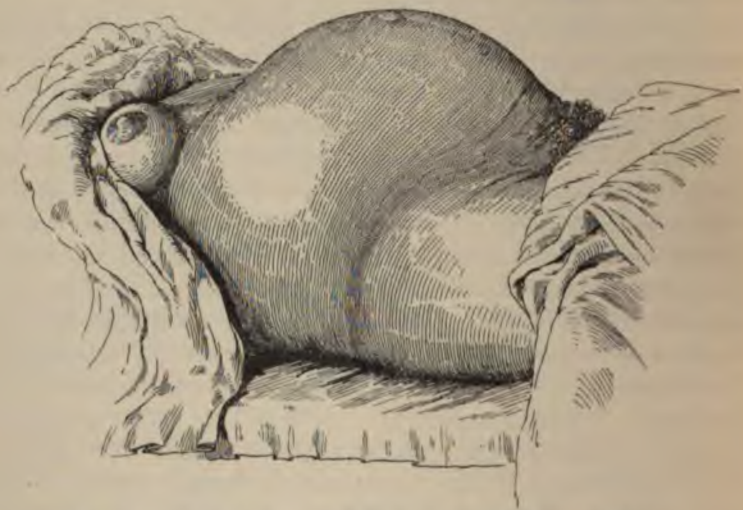


FIG. 125.—THE ABDOMEN OF A PREGNANT WOMAN AT TERM.

The patient should lie upon her back with the shoulders slightly raised, the knees slightly bent, and the abdomen completely uncovered. The hands should be warm, and should be used with gentleness ; if labour is actually in progress, the manipulations should be suspended during the pains. The level of the fundus should first be noted : it will usually be found about half-way between the umbilicus and the tip of the ensiform cartilage (fig. 125). The parts of the fœtus which can be recognised by palpation are the head, the breech, the back, the anterior shoulder, and the folded limbs lying upon the ventral aspect. In normal labour the head lies in the lower uterine segment and the breech at the fundus, and this is the only arrangement with which we are here concerned. The lower pole of the fœtus should first be palpated by placing the hands flat upon the lower part of the abdomen, in the position shown in fig. 126; the finger-tips are then directed downwards and inwards and steady pressure made so as to force them towards the pelvic brim, and at the same time approximate them to one another. This is called the *first pelvic grip*, and by it the lower pole of the fœtus may be grasped between the two hands and its characters made out. The head can be distinguished from the breech by the following points: it is harder than the breech, better defined in outline, and is separated from the trunk by a groove corresponding to the neck; by firmly drawing the fingers upwards

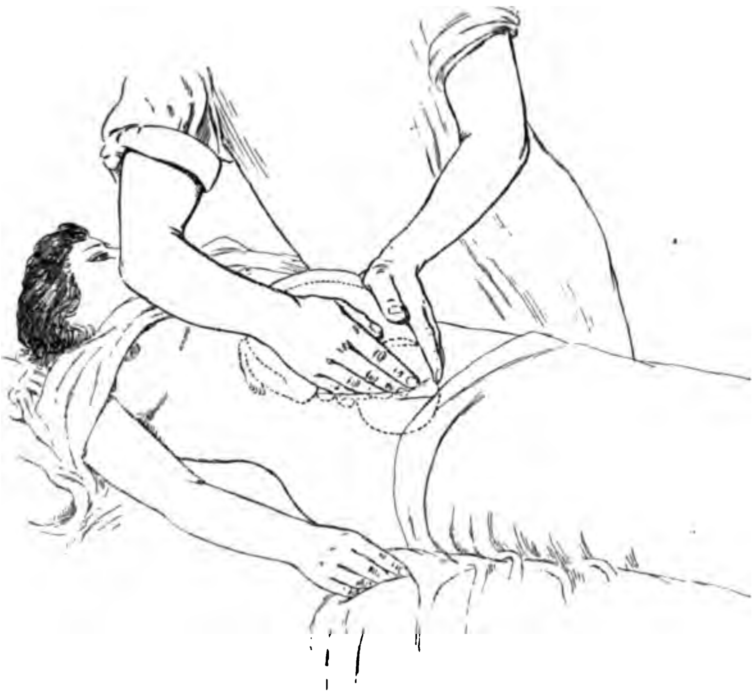


FIG. 126.—ABDOMINAL PALPATION: LOCATING THE HEAD IN THE PELVIC BRIM. THE FIRST PELVIC GRIP.

from the head to the trunk the presence of this groove can usually be determined. In a primipara, the head, at the commencement of labour, lies at a lower level than in a multipara, and it is therefore less easily reached by abdominal palpation. In a multipara the head usually lies above the level of the plane of·the brim at this stage of labour, and accordingly it can be more easily grasped. The head may then be better felt by the *second pelvic grip*, in which the ulnar margin of the hand is placed upon the pubes, and the thumb and fingers spread so as to include the head between them (fig. 127). It will be evident that the second pelvic grip will be more useful when the head is high, the first pelvic grip when the head is low. In the former case the head can be readily moved from side to side; in the latter case, as it lies in the pelvic brim, it is almost immovable.

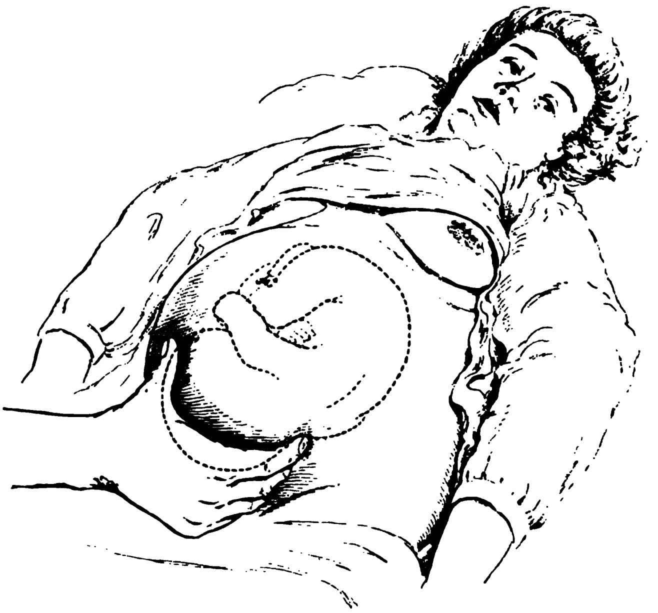


FIG. 127.—ABDOMINAL PALPATION. THE SECOND PELVIC GRIP.

The fundus of the uterus is next palpated with the two hands laid flat upon it; the breech in this position will be felt to be larger, softer, and more irregular in outline than the head; one buttock can often be felt as a distinct rounded prominence, with small parts moving spontaneously (feet) beside it; the buttock may also be felt to rotate.

The front and sides of the uterus are to be next palpated in order to locate the back and the limbs (fig. 128). It will be remembered that the head engages in one or other oblique diameter of the brim; in the first and second positions a large area of the back is accessible; in the third and fourth positions, however, only a small part of the back is accessible, while the limbs will be readily felt (figs. 104 to 107). In *anterior* positions the back will therefore form an extensive smooth rounded surface, occupying the greater part of the uterine area which is accessible to palpation; at one side or the other of the uterus small rounded prominences corresponding to the folded limbs will be felt; they may be observed to move spontaneously. In *posterior* positions, on the other hand, the smooth area of the back will be missed, while the limbs will be readily felt over the greater part of the front of the uterus.

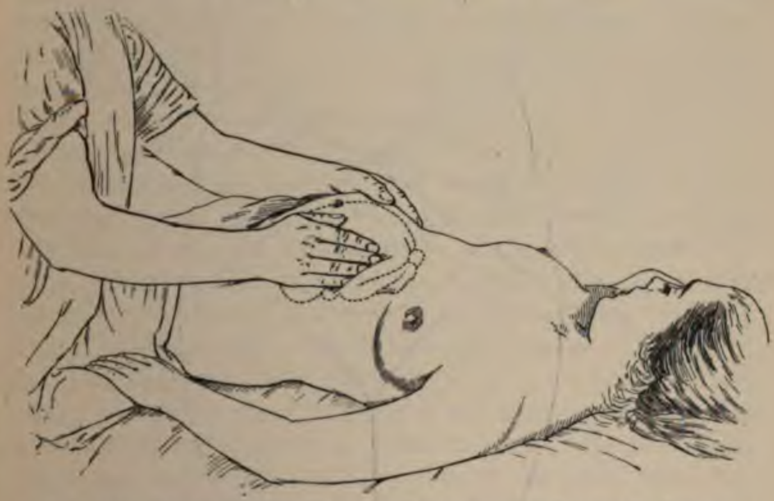


FIG. 128.—ABDOMINAL PALPATION: LOCATING THE BACK AND LIMBS OF THE FŒTUS.

The position of the anterior shoulder should also be sought. It forms a comparatively well-marked prominence a little above the head, and will be found to the right of the middle line in second and third positions, to the left in third and fourth positions; it is nearer the middle line anterior than in posterior positions (figs. 104 to 107).

It will now be apparent that it is possible to make a c plete diagnosis of presentation and position from abdomi palpation alone. Thus the head is in the pelvic brim—*ver* *presentation*; the back is readily felt—*anterior* (*first or seco* *position*; in addition, the limbs are to the right, the ante shoulder to the left of the middle line—*first position* back cannot be located, but the limbs are readily felt— (*third or fourth*) *position*; in addition, the anterior is to the right of the middle line—*third position*.

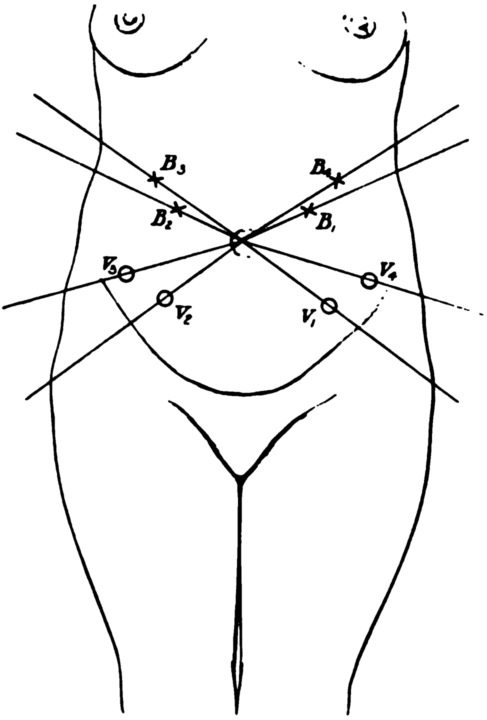


FIG. 129.—THE POINTS OF MAXIMUM INTENSITY OF THE FŒ HEART-SOUNDS IN VERTEX AND BREECH PRESENTATIONS.

V = vertex presentation. B = breech presentation.

Auscultation of the fœtal heart also yields v formation in diagnosis; not only does it indicate p and position by the locality over which it is audible heard it also proves that the fœtus is living, while by the changes which it undergoes during labour timely warning of danger to the fœtus may be given.

The fœtal heart-sounds can best be heard by using a single wooden stethoscope and pressing it firmly against the abdominal wall over the back of the fœtus. The area of the fœtal back over which the heart-sounds are heard is the scapular region. The position occupied by this area in relation to the mother's abdominal wall varies with both presentation and position (see figs. 104 and 148), and the stethoscope must be moved from place to place until the point of *maximum intensity* of the sounds has been located. In the first and second positions of the vertex the heart-sounds are heard best at a point about midway between the umbilicus and the anterior superior iliac spine—on the left in the first position, on the right in the second (fig. 129). In the third and fourth positions they are best heard at a slightly higher level, but further away from the middle line towards the flank —on the right in the third position, on the left in the fourth. When palpation fails to settle the diagnosis of position, it is clear that valuable aid can be obtained by localising the point of maximum intensity of the fœtal heart-sounds. The rate of the fœtal heart-sounds at term varies from one hundred and twenty to one hundred and forty per minute; sex has no definite influence upon the rate, but the size of the fœtus has, and it has been found that a large child has usually a slower heart-beat than a small one. The fœtal heart-rate is slowed during the uterine contractions, but quickly recovers when they pass off. Progressive slowing of the rate during prolonged labour indicates that the fœtus is suffering from the effects of pressure, and forms an indication for rapid termination of labour. Undue rapidity is also an unfavourable sign. If the rate falls below one hundred or rises above one hundred and fifty, danger to the child is certain. It is accordingly of importance to count as well as to locate the fœtal heart-sounds.

Vaginal Examination.—This method must be employed as little as possible during labour, owing to the attendant risks of infection. Nearly all the information required can be obtained, as we have seen, by abdominal examination alone, and in normal labour vaginal examination for diagnosis is often unnecessary. It may, however, be required to determine the onset of labour, or to watch the process of dilatation of the cervix.

For a vaginal examination during labour the British practice is to place the patient upon her left side in the semi-prone (Sims's) position, and in this position women are usually delivered (fig. 130). Modifications of this posture are required under special circumstances which will be afterwards indicated. In the case of a primigravida the head will be found on vaginal examination at the onset of labour, to be lying low enough in the pelvis for the finger to reach it readily, and to make out its rounded outlines and hard solid consistence. Its greatest circumference still lies above the brim, and it can be pushed upwards by firm pressure from below; it is then said to be *engaged* in the brim. In the case of a multipara the head will be at a higher level, often entirely above the brim, and therefore *not engaged*. It follows that while on abdominal examination the head is more easily palpated in a multipara than in a primigravida, on vaginal examination the converse is the case. Where in a primigravida the head is not engaged at the onset of labour, some cause of obstruction should be suspected and sought for.

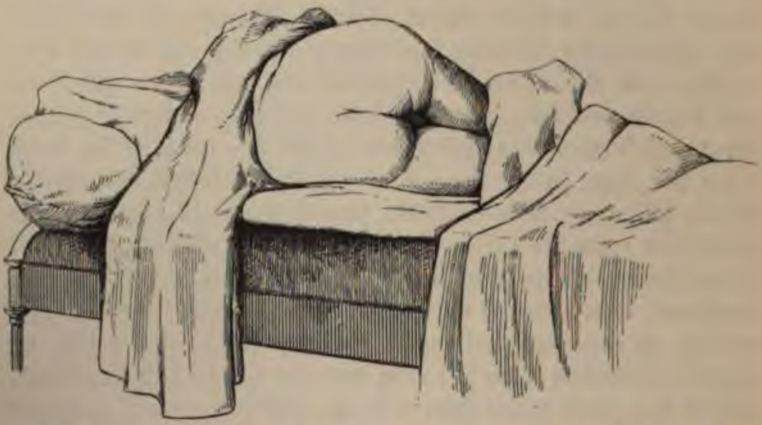


FIG. 130.—THE SEMI-PRONE OR SIMS'S POSITION. PATIENT PREPARED FOR VAGINAL EXAMINATION.

While the cervix is undilated and the membranes are unruptured, the sutures and fontanelles cannot be distinctly felt, and great care must be exercised in avoiding accidental rupture of the bag of waters. Diagnosis of position by vaginal examination must usually be postponed until the second stage, when the necessary particulars can be made out without difficulty. In the *first* position the posterior fontanelle will be felt in the left anterior quadrant of the pelvis; the sagittal suture runs backwards and to the right in the line of the right oblique diameter, and the anterior fontanelle is out of reach (figs. 131, *a*, and 110). When internal rotation has occurred, the posterior fontanelle will be found in the middle line anteriorly. The disposition of the sutures and fontanelles in the second position is shown in fig. 131, *b*. In the case of the posterior positions, the degree of flexion present influences the disposition of the sutures and fontanelles to a considerable extent; when the head is flexed, the posterior fontanelle can be felt in one or other posterior quadrant of the pelvis, the anterior fontanelle being out of reach (fig. 132, *a*). If, however, flexion is deficient, the anterior fontanelle comes within reach and can be felt in the anterior quadrant of the pelvis, while the posterior fontanelle can barely be reached at all

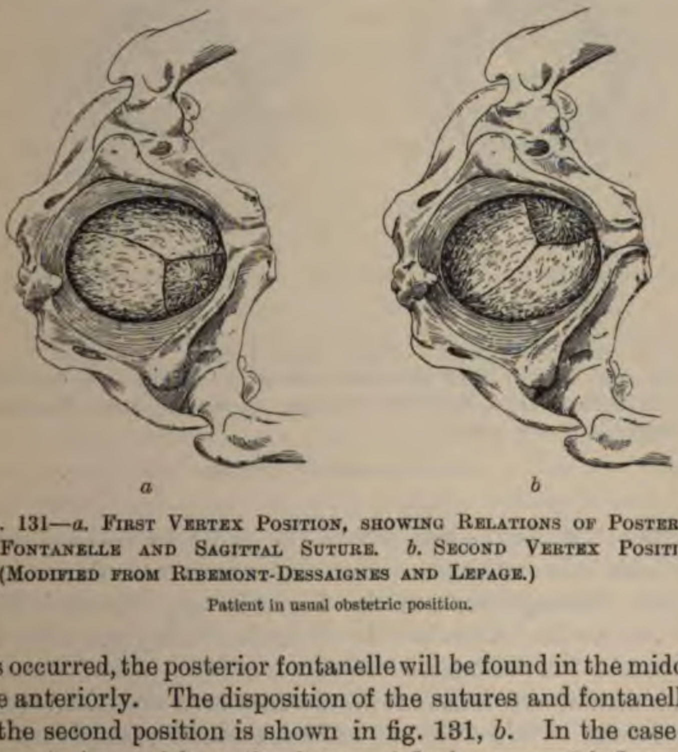


FIG. 131—*a*. FIRST VERTEX POSITION, SHOWING RELATIONS OF POSTERIOR FONTANELLE AND SAGITTAL SUTURE. *b*. SECOND VERTEX POSITION. (MODIFIED FROM RIBEMONT-DESSAIGNES AND LEPAGE.)

Patient in usual obstetric position.

(fig. 132, *b*). Sometimes difficulty arises in the second stage owing to the formation of a large caput succedaneum which obscures the sutures and fontanelles. The best guide to position then is the ear, which can easily be reached when the head is low; the curve of the helix is towards the occiput.

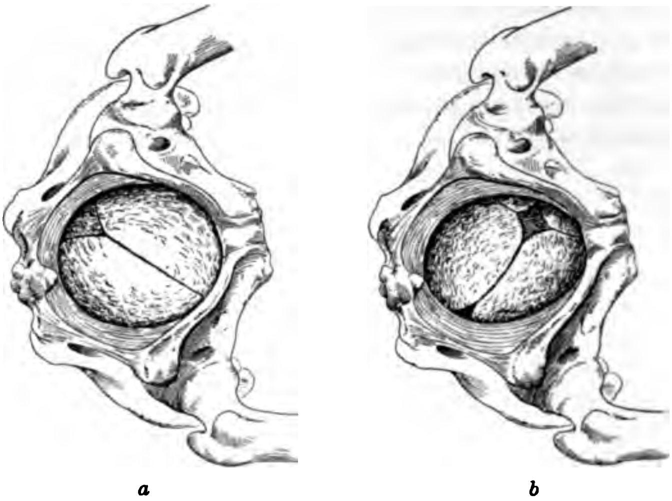


FIG. 132—*a*. THIRD VERTEX POSITION, HEAD FLEXED. *b*. FOURTH VERTEX POSITION, HEAD PARTLY EXTENDED, SHOWING ANTERIOR AND POSTERIOR FONTANELLES AND SAGITTAL SUTURE. (MODIFIED FROM RIBEMONT-DESSAIGNES AND LEPAGE.)

Patient in usual obstetric position.

III. **Management of the First Stage.**—There is little for the medical attendant to do during this stage after the diagnosis has been satisfactorily made; a skilled nurse is quite as well able to attend to the patient's wants and watch the course of labour as a qualified medical practitioner. A single vaginal examination for diagnostic purposes at this period should be enough; any succeeding examination made to watch the process of the stage of dilatation should be conducted with strict and conscientious antiseptic precautions.

During this stage the patient may be allowed to walk about or sit, or assume any position in which she is for the time easy. An enema should be given as soon as labour has definitely begun, to ensure the rectum being empty at the time of delivery; and evacuation of the bladder from time to time should be secured, either spontaneously or by the use of the catheter if necessary. Fluid nourishment can be given freely if the patient is not sick; vomiting at this stage is neither unusual nor of serious import.

As soon as the membranes rupture, whether at the end of this stage or prematurely, an examination should at once be made in case prolapse of the cord may have occurred (see p. 280). The disposition of the sutures and fontanelles can now be made out with comparative ease. The transition from the first to the second stage is marked by a change in the condition of the patient and in the character of the pains, which has been already described. In a normal labour proceeding without undue delay, two vaginal examinations, one at the first visit and one after rupture of the membranes, are all that is required.

Apart from the slightly blood-stained 'show' at the commencement of labour, there is no hæmorrhage during the first stage in a normal case. No anæsthetics or sedatives should be given when this stage is running a normal course.

Management of the Second Stage.—During this stage the patient must lie down; the medical attendant cannot leave her except for a very short time, and he should even then remain within easy call. The pains of this stage are severe, and the voluntary efforts of the accessory muscles exhausting; an anæsthetic will probably be demanded by the patient, and may be safely administered. Surgical anæsthesia is not required except at the time of actual delivery, when the head is emerging from the vulva; the pains then become very severe, and are accompanied by violent straining which may do harm. Partial anæsthesia may, however, be maintained during the greater part of this stage without injury to the patient or the fœtus; it is best carried out by the administration of chloroform by the open method upon a handkerchief or a flannel mask. If an inhaler is preferred, that of Junker is the safest and most convenient. Chloroform should be given only during the pains; in this way sufficient will be taken to relieve the patient's suffering and cause her to sleep during the intervals. While no harm ever comes from giving chloroform for a considerable time in this manner, it should be remembered that complete anæsthesia, when prolonged, may lead to uterine inertia and troublesome post-partum hæmorrhage.

It is unnecessary to make vaginal examinations to watch the descent of the head, for the appearances described on page 170 will indicate when the head has reached the vulva. The work of the medical attendant may now be said to begin; his duty being to control the passage of the head and body of the fœtus through the vulva, and as far as possible to avoid injury to the pelvic floor. In this country women are usually delivered lying upon the left side, with the thighs partly flexed and the knees held apart by an assistant.

Time should be allowed for the actual expulsion of the head, especially in the case of a primipara, or whenever the perineal body appears to be unusually resistant. The patient should be directed not to 'bear down' or hold her breath; if she can be taught to breathe in rapid shallow respirations of 100–120 to a minute, straining will be entirely eliminated. If the pains are very strong and frequent, the administration of chloroform should be pushed so as to produce surgical anæsthesia. It is usual to speak of the process of assisting the delivery of the head as 'supporting the perineum.' This expression is unfortunate, for attention should be mainly directed, not to the perineum, but to the head; no amount of support applied to the perineum will prevent a threatening laceration unless the movements of the head can be properly directed. The object in view is to deliver the occiput first, and to prevent extension of the head from taking place until the bi-parietal diameter is free from the vulva. This implies that the natural tendency to extension of the head (see p. 212) must be resisted up to a certain point. By making pressure upon the stretched perineum with the palm of the hand, and at the same time allowing the occiput to protrude beneath the symphysis, the head will be kept from extending until the wide posterior part (bi-parietal diameter) has escaped. The head may then be allowed gently to extend at the end of a pain, the face and chin being slowly levered over the perineum during an interval. This method has a definite mechanical advantage. If the head does not extend until the parietal eminences are free, extension brings successively the sub-occipito-bregmatic, sub-occipito-frontal, and sub-occipito-mental diameters (each measuring about three and three-quarter inches) through the antero-posterior diameter of the outlet (fig. 133). If, however, the head should extend before this, the occipito-frontal (four and a-half inches) or the occipito-mental (five inches) diameters must pass through the outlet, or, if not these, then certain intermediate diameters necessarily longer than the sub-occipito-bregmatic and sub-occipito-frontal. It will thus be seen that the important point is not the support given to the perineum, but the attitude of the head when escaping from the vulva. In spite of all precautions a certain amount of laceration almost always occurs in a primipara, and even when the perineal body seems intact externally there may be considerable laceration of the lower part of the posterior vaginal wall.

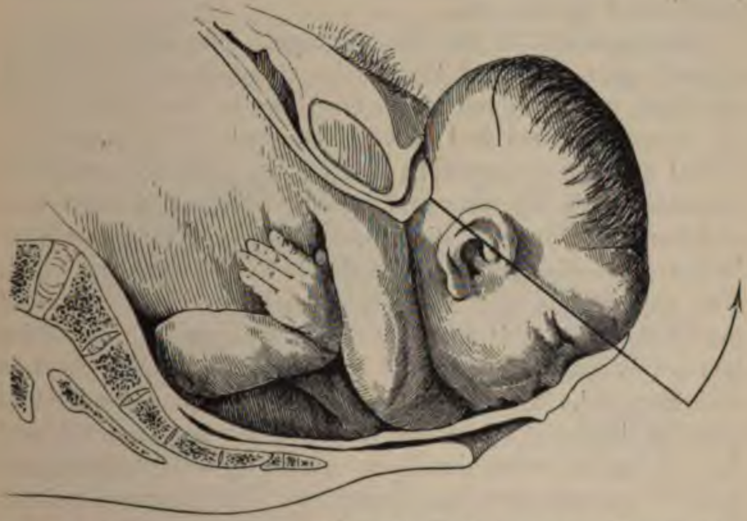


FIG. 133.—EXTENSION OF THE HEAD (THIRD MOVEMENT) IN PASSING THE PELVIC OUTLET; SUB-OCCIPITO-FRONTAL DIAMETER ENGAGED; THE BI-PARIETAL DIAMETER IS FREE. (BUMM.)

After the expulsion of the head has taken place, a pause in the uterine contractions occurs. The child's eyes should now be wiped with pledgets of cotton-wool soaked in boric lotion, and if the cord encircles the neck it should be pulled over the occiput and freed. If the pause is a long one, the face will become cyanosed from the pressure exerted upon the neck by the vulva. As soon as the uterus contracts again, the movement of external rotation will be observed, and when the bis-acromial diameter has entered the antero-posterior of the outlet, delivery of the body may be assisted by drawing the head *gently* forwards round the symphysis and making pressure with the other hand upon the uterine fundus. In case of difficulty the index finger may be hooked into the axilla of the posterior shoulder, and traction thus made upon the trunk, *in the axis of the pelvic outlet*. In order to secure proper retraction of the uterus, the hand must not leave the fundus during the delivery of the body of the child, if the body is delivered by traction.

Management of the Third Stage.—The labour has now entered upon the third stage; the attention of the medical attendant will be given to the condition of the uterus, while the nurse ligatures and divides the cord. This apparently trivial procedure should be carried out with due antiseptic precautions, the ligatures and scissors being boiled before use, and the hands properly disinfected; it is of great importance in the prevention of umbilical sepsis in the new-born child. The cord should not be divided until the child has cried loudly, respiration is properly established, and the pulsation has nearly ceased. The child is then wrapped up in blankets and removed. The perineum should next be examined to note the degree of laceration, if any, which has occurred, and in so doing the vulva should be opened up with clean fingers, so as to bring the posterior vaginal wall into view (see p. 539). The patient should now lie upon her back, for in that position the uterus can be controlled much more easily and effectually than in the side position. Nothing should be done except gently to massage the uterus until it is perceived by the signs described on page 171 that the placenta has been expelled from it. Here again a vaginal examination is unnecessary, for the placenta can usually be delivered by a voluntary bearing-down effort on the part of the patient, aided by the medical attendant grasping the uterus and pushing it downwards and backwards in the axis of the pelvic brim. When it is certain that the placenta has left the uterus, pressure upon the fundus may be aided by gentle traction upon the umbilical cord; this must never be done, however, while the placenta remains attached to the uterus. When the placenta appears at the vulva, it should be received in the hands and rotated so as to twist the membranes which follow it into a rope, which gradually comes to an end and slips out without any traction having been made (fig. 134). In this way tearing of the membranes, leading to retention of a portion in the uterus, is avoided.

If after waiting for at least an hour it is found that the placenta still remains in the uterus, an attempt may then be made to effect its expulsion by the manipulation of Crédé, often called 'expression of the placenta.' This consists in gently rubbing the uterus so as to bring about a firm contraction, and then compressing it strongly in the grasp of one or both hands, at the same time pressing the whole organ downwards and backwards into the pelvic cavity (fig. 135). The partially detached placenta can in this way often be squeezed out of the uterus, but certain disadvantages always attend this manœuvre—viz. (1) portions of the placenta and of the membranes may be left attached to the uterine wall, being torn away from the bulk of the after-birth; (2) if the uterus is thus compressed during relaxation, the process of inversion may be started (see p. 345). It must therefore be clearly understood that the Crédé method is not to be employed merely to save time, but only in cases where the spontaneous separation of the placenta is unduly delayed. With the aid of anæsthesia, the placenta can often be delivered by this method, although it may have proved unsuccessful without anæsthesia, but the risk of retention of a portion of the after-birth is naturally greater.

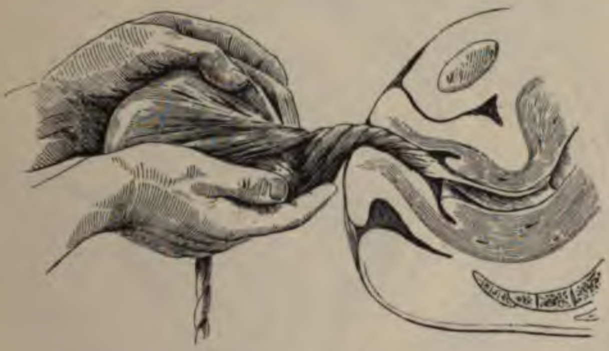


FIG. 134.—DELIVERY OF THE MEMBRANES. (BUMM.)

Prolongation of the third stage, if not accompanied by considerable hæmorrhage, is not of itself disadvantageous to the patient. There is therefore no need for hurry, and it must be borne in mind that natural separation of the placenta is much to be preferred to its artificial removal, and is worth waiting for.

After a normal labour vaginal douching is unnecessary, but the nurse should thoroughly swab the vulva with an antiseptic solution (*e.g.* 1–2,000 biniodide of mercury), and all perineal tears of half an inch or more must be immediately repaired. The uterus should be continuously massaged for ten to fifteen minutes after the delivery of the after-birth, and gently but firmly squeezed to expel any blood-clot that may have remained within it (fig. 136). Persistence of hæmorrhage at this time is frequently due to the presence of a clot in the uterus, and when this has been squeezed out the

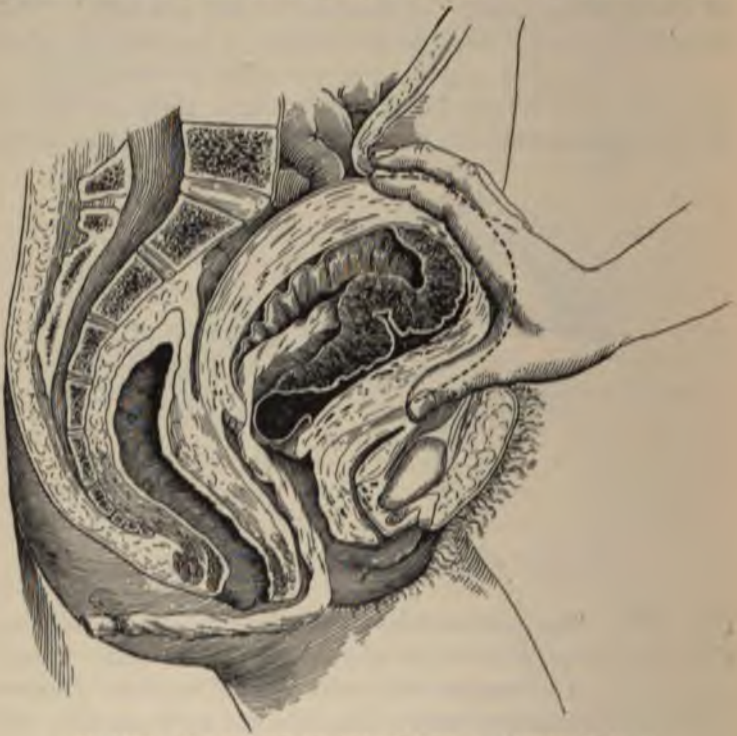


FIG. 135.—EXPRESSION OF THE PLACENTA. (AFTER CRÉDÉ.)

bleeding immediately ceases. If a clot is allowed to remain in the uterus, although hæmorrhage may cease, the patient is liable to (1) severe after-pains; (2) delayed involution; (3) sapræmia. Should the uterus still tend to become flabby, a dose of ergot may be given, either by the mouth in the form of liquid extract of ergot ʒj., or preferably by deep intramuscular injection into the buttocks in the form of injectio ergotinæ hypodermica (B.P.) or 'aseptic ergot.' This drug is seldom required by a primipara, but there is no objection to its routine use in multiparæ. Finally an abdominal binder should be firmly applied, and a pad of sterilised absorbent cotton or gamgee tissue, or of corrosive-sublimate wool placed over the vulva.

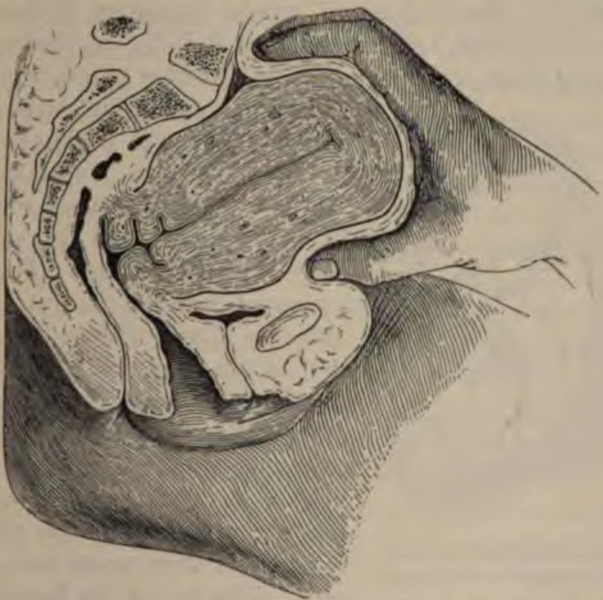


FIG. 136.—COMPRESSION OF THE FUNDUS IN ORDER TO EMPTY THE UTERUS AFTER DELIVERY OF THE PLACENTA. (EDGAR.)

Occipito-posterior Positions of the Vertex

The *diagnosis* of the posterior positions of the vertex has been already described (p. 225). The *mechanism* differs from that of the anterior positions in two particulars—(1) flexion is deficient in a considerable proportion of cases; this is due, as already explained, (*a*) to a tendency in posterior positions towards extension of the spine and therefore of the head; (*b*) to the obstacle offered by the pelvic walls to the descent of the occipital end of the head, while the sincipital end is free (p. 211); (2) the movement of internal rotation is unfavourably influenced, since either (*a*) a long movement of forward rotation, or (*b*) non-rotation, or (*c*) backward rotation must occur. If flexion is good and the head and pelvis are of normal size, the occiput will rotate forwards; if, however, flexion is deficient, or the pains are feeble, or if the head is unusually large, or the pelvis abnormally small, the head will either remain unrotated or the occiput will rotate backwards into the sacral hollow. When forward rotation occurs the case terminates in the same way as an anterior position; but when non-rotation or backward rotation occurs serious difficulty is met with in the expulsion of the head. Fig. 137 shows that in the latter position a part of the fœtal trunk enters the pelvic cavity along with the head and the vagina is consequently overdistended; expulsion of the presenting part is thus made more difficult. The part of the head which in this case first presents at the vulva is the region of the anterior fontanelle; the occipito-frontal diameter (four and a-half inches) is therefore engaged in the antero-posterior diameter of the cavity. The forehead first passes out beneath the symphysis pubis; then the perineum stretches and the occiput slips over it; finally the face passes under the symphysis, and thus the delivery of the head is completed by a movement of extension. It will be seen that much longer diameters of the fœtal head are engaged than when the occiput is anterior. Further, the wide posterior part distends the perineum, instead of emerging between the labia, and the risk of severe laceration is thus much increased.

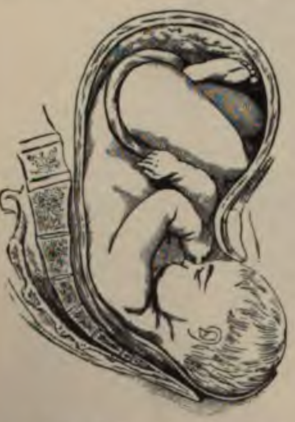


FIG. 137.—DELIVERY OF HEAD IN PERSISTENT OCCIPITO-POSTERIOR POSITION. (GALABIN.)

The chief object of the *management* of labour in occipito-posterior positions is to convert the case into an occipito-anterior. If the opportunity arises, this should be done by abdominal manipulation before labour, and in the case of a multipara when the head is not engaged it is comparatively easy. The whole trunk should be rotated gently with the two hands; the change in the position of the anterior shoulder will indicate the amount of rotation which has been accomplished. The amount of rotation required to change a third position into a second is not great (see figs. 105 and 106). After labour has commenced, since nine out of every ten cases end in forward rotation, nothing need be done until it becomes evident, during the second stage, that the occiput will not come forward. The main cause of non-rotation forward is deficient flexion, and it is obvious that if the head could be fully flexed, forward rotation might occur spontaneously. The advice often given under these circumstances, to promote flexion either by pushing up the sinciput with the fingers, or by pulling down the occiput with an instrument such as a vectis during the pains, although theoretically sound, is difficult to carry out effectually. It is almost always found that extension recurs, the reason being that it is associated with, and largely depends upon, extension of the spine; and the former probably cannot be corrected, except momentarily, apart from the latter. If, in a third vertex, the usual right obliquity of the uterus is exaggerated, flexion may be to some extent promoted by correcting the obliquity. This can be done by placing a thickly folded towel to the right of the uterus, putting on a tight binder, and keeping the patient on her left side. When the head reaches the pelvic floor with the occiput still posterior, and there is no sign of forward rotation occurring, it is better to terminate the case with forceps, first rotating both the head and trunk of the child so as to bring the back to the front.

This manœuvre is not always easy to carry out, and an anæsthetic must be given in all cases. The position of the child should first be accurately diagnosed, and the anterior shoulder localised. With the patient in the usual side position, the right hand is introduced entirely into the vagina so as to obtain a firm grip of the head. The left hand is then employed to make pressure upon the anterior shoulder, pushing it up to the middle line of the body, while the head in the vagina can at the same time be rotated so as to bring the occiput forward. It is desirable to rotate the trunk, for, unless this is accomplished, rotating the head will merely twist the neck and will fail to reduce permanently the occipito-posterior position, since the head will resume its normal relation to the trunk as soon as the hand is removed from the vagina. When, however, little liquor amnii remains in the uterus, rotation of the trunk is almost impossible, and it is then best to rotate the head as much as possible, and, while the hand keeps it in its corrected position, to apply the forceps immediately, before the head can return to its faulty position. The non-rotated or imperfectly rotated head can usually be delivered with forceps, but serious lacerations of the pelvic floor involving the rectum will inevitably occur in a primipara; in a multipara there may be no serious injury if the head and the pelvis are of normal size.

The *moulding* of the fœtal head in occipito-posterior positions differs somewhat from that in anterior positions. The compression of the sub-occipito-bregmatic plane is exaggerated, and the frontal bones are more markedly displaced beneath the parietal bones. The position of the caput has been already mentioned (p. 217).

PART IV

ABNORMAL LABOUR

In this section the following conditions will be considered:

(I.) *Abnormal Presentations.*
 Face and brow presentations.
 Breech or pelvic presentations.
 Transverse or shoulder presentations.
 Twin labour.
 Prolapse of the cord and limbs.

(II.) *Abnormal Conditions of the Maternal Passages.*
 (*a*) *The bony pelvis.*
  Pelvic contraction.
  Tumours of the pelvic bones.
 (*b*) *The soft parts.*
  Ovarian tumours.
  Uterine tumours.
  Rigidity of the cervix.
  Rigidity of the pelvic floor.

(III.) *Abnormalities in the Action of the Uterus.*
 Precipitate labour.
 Uterine inertia.
 Tonic uterine contraction.
 Premature rupture of the membranes.

(IV.) *Obstructed Labour.*

(V.) *Maternal Injuries in Parturition.*
 Rupture of the uterus.
 ,, ,, ,, cervix and vagina.
 ,, ,, ,, perineum and vulva.
 Hæmatoma.
 Inversion of the uterus.

(VI.) *Ante-partum Hæmorrhage.*

(VII.) *Non-expulsion of the Placenta.*

(VIII.) *Post-partum Hæmorrhage.*

(IX.) *Labour complicated by Eclampsia.*

Face Presentations

Presentation of the face is brought about by complete extension of the head upon the spinal column, the occiput resting against the cervical vertebræ, and the chin being widely separated from the chest-wall (fig. 138). It occurs in about 1 in 250 labours. Little is known of the conditions which occasion this complete extension of the head, but it is believed that the following may be either essential or contributory causes :

1. Extreme obliquity of the uterus.
2. Pelvic contraction.
3. Large size of the fœtus.
4. Dolicho-cephalic fœtal skull (long antero-posterior diameters).
5. Congenital malformations—*e.g.* goître and anencephaly.
6. Multiparity.
7. Placenta prævia and hydramnios.

Face presentation is very rarely met with in *pregnancy*, but appears to be usually produced at the onset of labour, by conditions which prevent the easy entrance of the vertex into the pelvic brim. Causes 1, 2, and 3 therefore need no comment; the influence of uterine obliquity in causing extension of the head has been referred to on page 207. Considerable doubt exists whether the elongation of the antero-posterior diameters of the fœtal head which is often met with in face cases is primary or secondary, many observers maintaining that it is produced during labour, and is therefore the effect, not the cause, of the presentation. The congenital malformations mentioned have been responsible for the very rare instances in which face presentation has been recognised before labour. Statistics show that this presentation occurs in primigravidæ and multiparæ respectively in the proportion of two to three, and repeated presentation of the face has been observed in successive labours in the same patient.

Placenta prævia and hydramnios favour all kinds of abnormal presentation, but not especially that of the face.

The *attitude* of the fœtus is shown in fig. 138. It will be noticed that, while the limbs are flexed, the trunk and spine are extended; the outline of the back is flat, not convex, and is broken below by the prominence formed by the occiput. The interval seen between the knees and elbows is of course caused by the extension of the spine. Four *positions* are distinguished as follows, the chin being the denominator of the presentation:

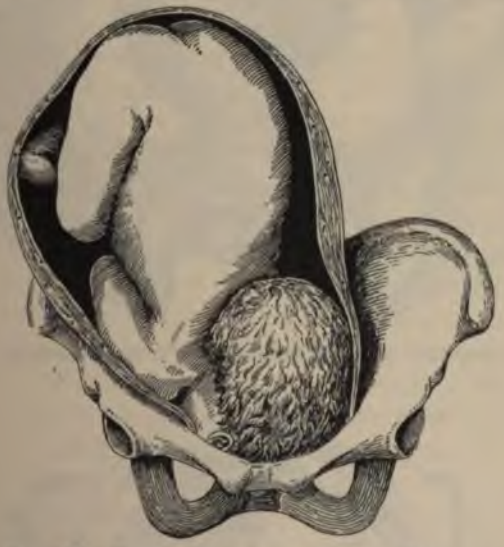


Fig. 138.—Face Presentation : First Position. (Ribemont-Dessaignes and Lepage.)

1st position	Right mento-posterior	R.M.P. (fig. 138)
2nd ,,	Left mento-posterior	L.M.P.
3rd ,,	Left mento-anterior	L.M.A.
4th ,,	Right mento-anterior	R.M.A.

The first position is by far the commonest, then comes the third; the second and fourth are extremely rare. The face therefore engages in the right oblique diameter of the brim in a very large preponderance of cases, just as does the vertex. The relation of the head to the pelvis at the commencement of labour is shown in figs. 139 and 140. By comparison with figs. 110 to 113 it will be seen that the presenting part occupies a comparatively small part of the pelvic space. In comparing the positions of the face with those of the vertex, it will be observed that they precisely correspond in respect of the position of the back of the fœtus; in the first and second positions it is anterior, in the third and fourth posterior, in both presentations. Thus, if in a first vertex position the

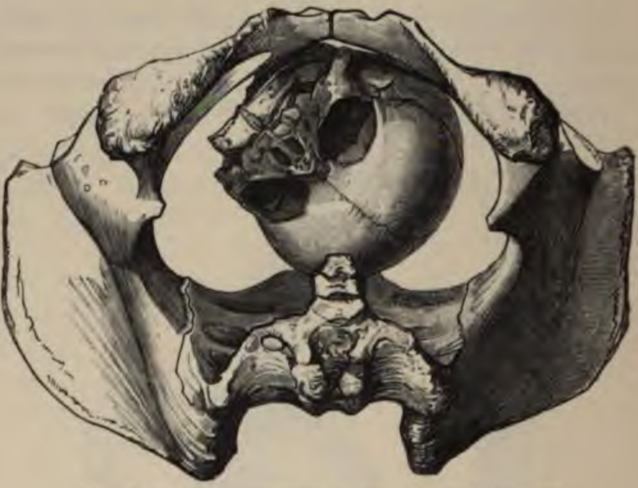


FIG. 139.—FACE PRESENTATION: THIRD POSITION.

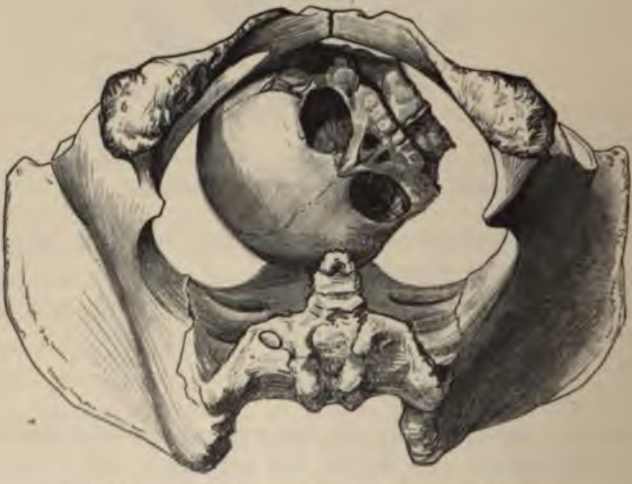


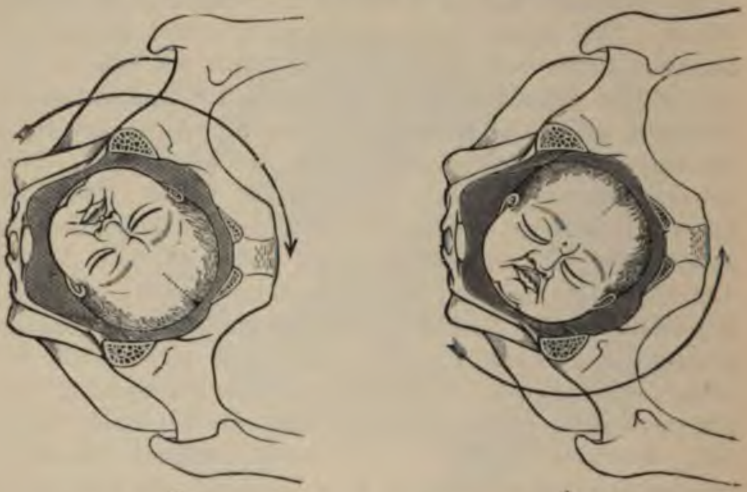
FIG. 140.—FACE PRESENTATION: FOURTH POSITION.

head became completely extended, a first position of the face would result from it.

Diagnosis.—*Abdominal palpation* should be carried out in the systematic manner described in connection with normal labour. The actual shape of the fœtal ovoid will attract attention if the back is anterior (fig. 138); the head in this case will lie well above the pelvic brim at the commencement of labour, even in a primipara, and the prominent occiput, or the sulcus between it and the back, can be palpated. It is not nearly so easy to make out the whole outline of the back as in a vertex presentation, for a considerable interval exists between the back and the maternal abdominal wall in the upper dorsal region. In palpating from the fundus downwards, the outline of the back is therefore lost before the occipital prominence is reached. When the back is posterior, the prominent occiput is not readily accessible to palpation; but the small parts representing the limbs are extremely easily felt. *Auscultation* affords little help in diagnosis; the heart is heard at a somewhat higher level than, but otherwise in the same position as, in vertex presentations; and in anterior positions of the chin the sounds are unusually distinct, as the chest is thrown forwards against the abdominal wall.

Vaginal examination at the commencement of labour is indecisive; the presenting part lies high and is ill defined in outline; it will often be impossible to distinguish it from the breech. When the first stage is more advanced, the bag of waters will be noticed to be unusually large, and premature rupture of the membranes is fairly common. The large size of the bag is due to the fact that, as the face does not fill the lower segment so well as does the vertex, a larger amount of liquor amnii descends below the presenting part. Great care should be taken not to rupture the membranes accidentally, but during the intervals between the pains it will probably be possible by gentle touch to recognise (*e.g.* in the third position) the frontal suture leading anteriorly to the orbital ridges and to the nose (fig. 139). At a still later stage, when extension of the head has become complete and the cervix is further dilated, it will be found that the orbital ridges, mouth, and chin can all be reached and recognised by the finger. The direction of the chin will of course indicate which of the four *positions* of the face is present (see figs.

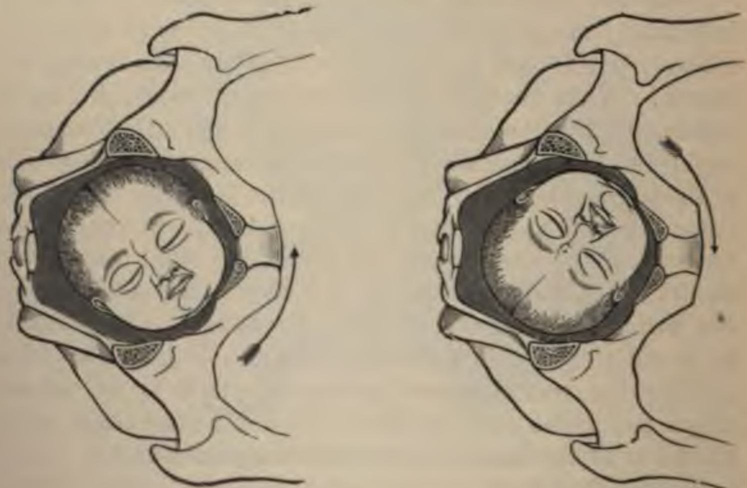
141 and 142). During the second stage diagnosis by vaginal examination may become very difficult owing to the tumefaction of the brow, cheeks, and lips (caput succedaneum),



a *b*

FIG. 141.—FACE PRESENTATION. *a.* FIRST POSITION. *b.* SECOND POSITION. (FARABŒUF AND VARNIER.)

The arrow indicates the line of forward rotation. Patient in usual obstetric position.



a *b*

FIG. 142.—FACE PRESENTATION. *a.* THIRD POSITION. *b.* FOURTH POSITION. (FARABŒUF AND VARNIER.)

The arrow indicates the line of forward rotation. Patient in usual obstetric position.

which results from pressure around the girdle of contact. The orbital ridges become obscured, the mouth opens, and may easily be mistaken for the anus; the nose undergoes least alteration, and consequently the nares with the septum between them may still be recognisable (fig. 143) when the other parts have become completely obscured.

Mechanism.—(1) *Extension* in a face presentation corresponds with flexion in a vertex. It is produced at the onset of labour by the conditions named above, and is progressive, being frequently incomplete until the head has descended well into the pelvic cavity. When completely extended the diameter of engagement is the sub-mento-bregmatic (three and three-quarter inches), which lies in one of the oblique diameters of the brim (four and three-quarter inches); when incompletely extended a longer diameter, the sub-mento-vertical (four and a-half inches), becomes engaged. The greatest transverse diameter of the face (bi-malar) is considerably less than that of the vertex, the bi-parietal. There is thus no difference between a fully flexed vertex and a fully extended face in the length of the diameter of engagement, while the transverse diameter is smaller; but it must be remembered that while the size of the vertex may be reduced by moulding, the bones of the face are incompressible. Deficient extension influences a face presentation unfavourably by introducing a longer diameter of engagement.

(2) *Internal rotation* is probably controlled entirely by the slope of the pelvic floor; when the head is completely extended the chin is the lowest part, and therefore it first reaches the pelvic floor and is directed by the slope downwards and forwards under the pubic arch. Since the most frequent position is the right mento-posterior, this usually involves a long movement of rotation (about three-eighths of a circle) around the right wall of the pelvis. If the head is imperfectly extended so that the sinciput is lower than the chin, the latter will rotate backwards into the sacral hollow (*persistent mento-posterior position*). Natural delivery is then impossible, except in the case of a very small or macerated fœtus.

(3) *Flexion.*—After forward rotation of the chin has occurred, the head becomes disengaged by a movement of flexion, which thus takes the place of extension in a vertex presentation. The chin first emerges under the symphysis

pubis; then the face, forehead, vertex, and lastly the occiput pass successively over the perineum (fig. 143). It is important that the chin should be brought well forwards under the pubic arch before flexion occurs, otherwise the mento-vertical diameter (five and a-half inches) must pass through the outlet instead of the sub-mento-vertical (four and a-half inches). It is therefore clear that the passage of the head through the vulva in a face presentation is always more difficult than in a vertex presentation, owing to the greater length of the diameters of engagement.

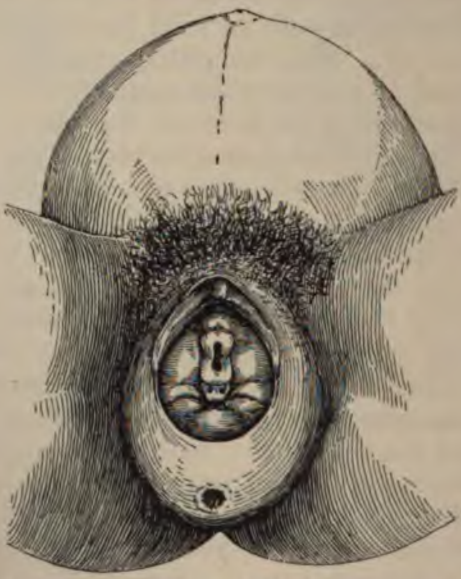


FIG. 143.—DELIVERY OF THE HEAD IN FACE PRESENTATION; MOVEMENT OF FLEXION. (RIBEMONT-DESSAIGNES AND LEPAGE.)

The swelling of the lips and the unaltered condition of the nares are shown.

(4) *Restitution* and *External rotation* are brought about by the same causes, and follow the same rule with regard to direction, as in vertex presentations.

The most favourable positions in presentation of the face are those in which the chin is anterior (third and fourth). In these the back is posterior, and the effect of its apposition with the maternal vertebral column is to extend the spine, and thus promote extension of the head—the normal mechanism of this presentation. In addition, the movement of forward rotation of the chin is much shorter than in the first and second positions.

The effects of labour upon the head of the fœtus are very marked. The tumefaction of the face has been already referred to; it is, of course, due to the formation of the caput succedaneum, but in this case the effusion is usually sanguinolent, giving the appearance of considerable bruising, often accompanied with small bullæ. The effusion, as a rule, becomes absorbed in a few days after birth, and the skin rapidly regains its normal colour. The changes produced in the shape of the skull are also shown in fig. 144. The vertex becomes flattened by being compressed against the pelvic wall, thus reducing the sub-occipito-bregmatic and sub-mento-bregmatic diameters, while the occipito-frontal diameter becomes considerably lengthened, the plane of principal compression being the plane of the sub-mento-bregmatic diameter.

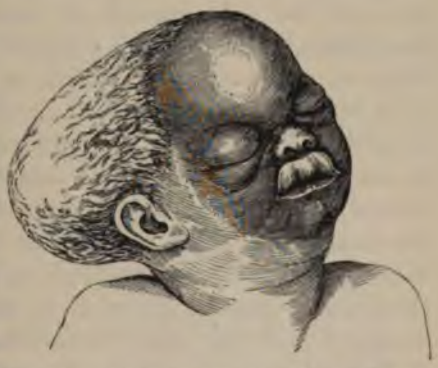


FIG. 144.—FACE PRESENTATION: THE HEAD OF THE CHILD AFTER DELIVERY. (RIBEMONT-DESSAIGNES AND LEPAGE.)

The mechanism of labour in a face presentation may be said to differ from that in a vertex mainly in the greater difficulty of the expulsion of the head and the more serious results of backward rotation. A face presentation, as a rule, brings no more risk to the mother than a vertex; labour is, however, longer, because the face is a less efficient dilator and the membranes are more liable to rupture early; further, as repeated examinations may be necessary for diagnosis, the strictest antiseptic precautions are called for. There is some increase of risk to the child, owing mainly to the comparative frequency of such complications as premature rupture of the membranes, and prolapse of the cord or of one of the arms.

Management of Face Presentations.—The possibility of the pelvis being contracted should always be borne in mind in connection with face presentations. Since the great majority of cases terminate naturally by forward rotation of the chin and spontaneous disengagement of the head, interference is not often called for. It is therefore the wisest plan to leave face presentations alone, and interfere only under certain well-defined conditions. The membranes should be very carefully preserved, for the face is an inefficient dilator; therefore vaginal examinations should be made with special care, and the patient kept lying down during the greater part of the first stage. During the second stage what is possible should be done to promote extension; forward rotation of the chin will then inevitably follow. Use may be made of uterine obliquity in promoting extension by directing the patient to lie upon the side opposite to that on which the chin has been located; but upward pressure with the fingers on the forehead or downward traction on the chin, if attempted, must be applied very carefully or the face may be seriously injured. If the chin rotates backwards, or if forward rotation is much delayed, the best treatment is to anæsthetise the patient, and then rotate the head and trunk so as to bring the chin forwards, in the manner already described in connection with posterior positions of the vertex (p. 239). The chin should then be pulled down until the face is completely extended, and the head immediately delivered with forceps. If forward rotation cannot be accomplished in this way, it may prove possible to deliver with forceps in the case of a small fœtus, even in the persistent mento-posterior position. If, however, this should fail, craniotomy will be required.

If the cord or an arm becomes prolapsed after rupture of the membranes, or if the pelvis is contracted and of the flat variety, version may be performed, either by the bi-polar or internal method (see p. 495).

It has been sometimes advised when a face presentation is recognised early in labour, before rupture of the membranes, that an attempt should be made to convert it to a vertex by flexing the head. It may be said that this
dure is unnecessary, difficult to carry out, and if not
etely successful it does harm by bringing about the most
urable of all cephalic presentations—viz. the *brow*.
plest and best method of attempting to flex the head
-manual method described by Herman. The fore-
ressed upwards by two fingers placed in the vagina;

this first raises the presenting part above the brim and then commences to flex the head. The other hand is placed over the lower uterine segment externally and used to press the occiput downwards into the brim. In this way the head may be rotated upon the occipito-atloid joint, so as to bring down the occiput and push up the face. When face presentation occurs with a contracted pelvis, the management of the labour will be governed mainly by the shape and size of the pelvis (see p. 302).

Brow Presentations.—When the head lies midway between the attitude of complete flexion and that of complete extension, the brow presents at the brim, and the longest diameter of the head (mento-vertical, five and a-half inches) becomes the diameter of engagement. The shape and size of the mento-vertical plane, as shown in fig. 145, make the passage of the normal sized head through the pelvis, when presenting in this way, well-nigh impossible. Probably this presentation should be regarded as a sub-variety of the face presentation, due to arrest midway of the process of extension.

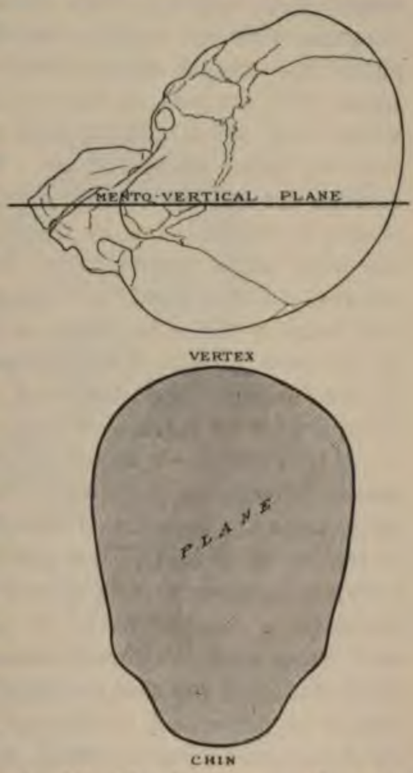


Fig. 145.—The Position and Shape of the Mento-vertical Plane. (Edgar.)

Diagnosis.—On vaginal examination the brow presentation is recognised by the presence of the anterior fontanelle at one end of the presenting part and the orbital ridges at the other. When the mouth and chin can be felt, the presentation is a face. It is fortunate that this presentation is rare (1 in 1,500 to 2,000 labours), for natural delivery is usually impossible unless the fœtus is undersized.

Mechanism.—The frontal bones may be either anterior or posterior in brow presentations, the former being the more favourable. An anterior brow may be delivered naturally if the head is small, the pelvis of normal size, and the uterus acting powerfully. Moulding then occurs, which results in marked compression of the mento-vertical diameter, and compensating elongation of the occipito-frontal; this causes great bulging of the frontal bones. The head then descends with the superior maxilla compressed against the pubes, the occiput lying in the sacral hollow; the frontal region first appears at the vulva, and is followed by the vertex and occiput, the mouth and chin being disengaged from the pubes the last of all. This method accordingly resembles the delivery of the vertex in face to pubes cases as shown in fig. 137, but in the case of the brow presentation the head is, of course, more extended. Very considerable deformity of the head, consisting of flattening of the vertex and bulging of the forehead, results. In posterior positions of the brow, forward rotation may occur, when the case ends in the manner just described; if rotation does not occur natural delivery is impossible.

Management.—It is probable that every face presentation passes through the preliminary stage of a brow presentation; many cases are accordingly observed to undergo spontaneous correction to a face. The persistence of this presentation, however, involves considerable risk both to mother and child; therefore, if detected early in labour, either before or soon after rupture of the membranes, bi-polar version should be performed, and the case converted into a breech. If version cannot be performed, an attempt may be made either to flex the head, producing a vertex presentation, or to extend it completely, producing a face; the latter is easier to perform, but great care must be taken not to injure the face or eyes. If the head is *fixed* in the brim, it must be allowed to continue as a brow presentation, and an attempt made to deliver with forceps as soon as the cervix is sufficiently dilated. Severe laceration of the vulva is often caused by the passage of the head. In fronto-posterior cases the difficulty is still greater, and craniotomy is usually required. Symphysiotomy has been practised in these cases as an aid to forceps delivery.

Breech or Pelvic Presentations

When the pelvic extremity of the fœtal ovoid lies at the brim, and the cephalic extremity at the fundus, the presentation is called a *breech*. If the normal attitude of flexion is unaltered the presenting part will consist of the buttocks with the external genital organs, and one or both feet, the latter lying somewhat above the former; this is called the *complete breech* (fig. 146). Some alteration of the normal attitude is, however, not uncommon. The most frequent is extension of the legs upon the thighs, bringing the feet up to the sides of the neck; this is called the *incomplete breech with extension of the legs* (fig. 147). Sometimes, however, the thighs are extended and the legs flexed, bringing the knees down into the brim; or, finally, both the legs and the thighs may be partially extended, bringing down the feet. The two latter are often termed *knee* and *footling presentations*, but they must of course be regarded, not as distinct from, but as varieties of, the incomplete breech presentation. Breech presentations may therefore be classified thus:

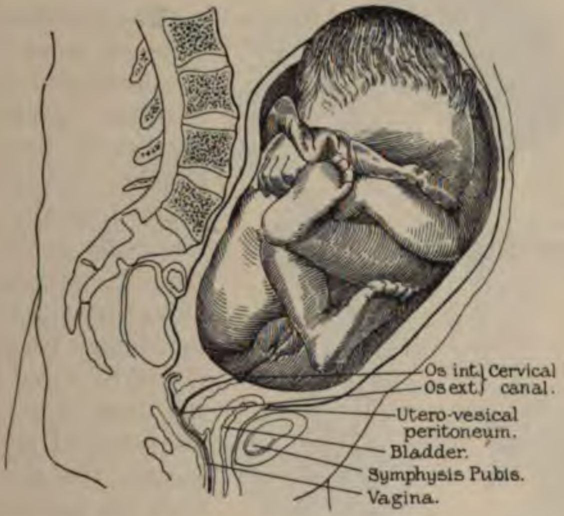


Fig. 146.—Complete Breech Presentation before Labour. From a Frozen Section. (Waldeyer.)

- *A*. Complete Breech Presentation.
- *B*. Incomplete Breech Presentation.
  - (1) With extended legs.
  - (2) With extended thighs.
    - (*a*) Knee (legs flexed).
    - (*b*) Footling (legs extended).

Occurrence.—Breech presentations occur in about 1-30 (3·3 per cent.) of all labours; if, however, premature labours are excluded, the proportion falls to 1-60, showing that this presentation is much more frequent in premature than in full-time labours. It is usually stated that breech presentations occur somewhat more frequently in multiparæ than in primigravidæ, but recent statistics from the Clinique Baudelocque (Paris) show that, excluding cases of contracted pelvis and of premature labour, the preponderance lies decidedly with primigravidæ. The incomplete breech presentation, in one or other of its forms, is commoner than the complete.

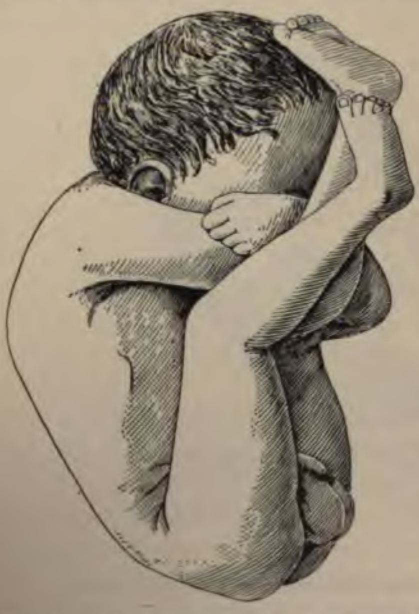


FIG. 147.—INCOMPLETE BREECH WITH EXTENSION OF THE LEGS. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Causes.—It is customary to ascribe breech presentation to disturbance of the conditions which produce vertex presentation (see p. 184). Thus the cephalic end of the fœtal ovoid may be larger than the pelvic end, as in *hydrocephalus*; the ower uterine segment may be unduly distended, and approxi-tely equal in size to the fundus, as in *hydramnios*; the tre of gravity of the *premature fœtus* lies near the centre e body, and therefore the tendency to lie head downward e liquor amnii is lost in premature labours. In addition, *placenta prævia* favours the occurrence of breech presentation, for the presence of the placenta in the lower uterine segment diminishes the capacity of this part of the uterus, and so tends to displace the head when presenting. *Pelvic contraction* produces much the same result. It must, however, be admitted that many breech presentations occur in which none of these conditions are present, and they must therefore be regarded as merely contributory causes.

Four positions of the breech presentation are described, the sacrum being the denominator:

1st position	Left sacro-anterior	L.S.A. (fig. 148)
2nd "	Right sacro-anterior	R.S.A.
3rd "	Right sacro-posterior	R.S.P.
4th "	Left sacro-posterior	L.S.P.

Diagnosis.—Abdominal palpation should be carried out in the systematic manner described on page 222. It is much easier to recognise a breech presentation by abdominal than by vaginal examination in the earlier stages of labour. The pelvic grip will show that the fœtal pole which occupies the lower part of the uterus does not possess the characteristics of the head; it is softer, more irregular, and less defined in outline; it usually lies above the level of the brim, and small parts moving spontaneously may be felt near it. The fundus must next be palpated with great care, when the head will be recognised by the points mentioned on page 223; it is often extraordinarily movable from side to side. Back and limbs will be found in the same way as with vertex presentations. In the incomplete breech presentation with

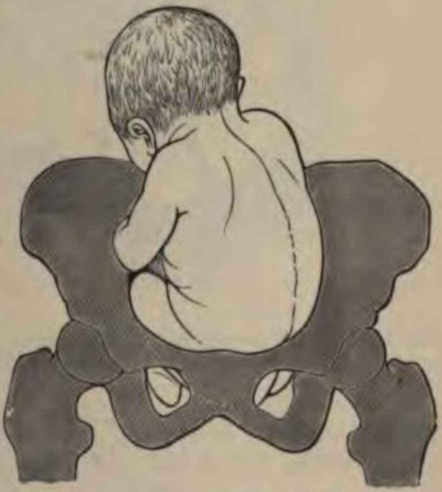


FIG. 148.—BREECH PRESENTATION: FIRST POSITION. (FARABŒUF AND VARNIER.)

extended legs the feet lie close to the head and may be felt there *per abdomen* (fig. 147); care will then be necessary to avoid the error of concluding that the breech lies at the fundus because small parts are found near it. The *heart-sounds* will be heard at about the level of or a little above the umbilicus—*i.e.* somewhat higher than in vertex presentations, but in much the same relative positions as regards the middle line (fig. 129). In the first breech position the heart-sounds are unusually loud, owing to the fact that the back of the left shoulder is in close contact with the abdominal wall, a little to the left of the umbilicus (fig. 148).

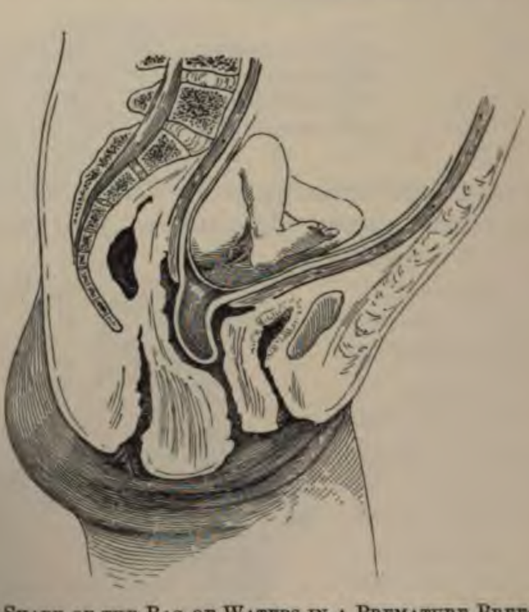


FIG. 149.—SHAPE OF THE BAG OF WATERS IN A PREMATURE BREECH LABOUR. (MODIFIED FROM RIBEMONT-DESSAIGNES AND LEPAGE.)

Vaginal examination early in labour will show that the
senting part lies high and cannot easily be defined; the
x dilates slowly and the bag of waters becomes unusually
ted, assuming a sausage shape, which is fairly charac-
of this presentation (fig. 149). This alteration in the
f the bag of waters results from the small size of the
ng part allowing an unusually large amount of liquor
descend below it, thus elongating the membranes.

Sometimes the presence of a small part (foot) can be detected in the bag of waters. Details of the presenting part cannot definitely be made out until the cervix is one half dilated or the membranes have ruptured; but at this stage the examining finger will first come into contact with the anterior buttock—smooth, soft, and round in outline. Exploring further, the anus will be found, and beyond it again the coccyx and lower sacral vertebræ, the latter being recognisable by their row of small spinous processes. On the side of the pelvis opposite to that occupied by the sacrum one or both feet may be found (fig. 150). The male external genital organs may also be recognised and the sex thus determined. The presence of meconium on the examining finger which has been passed into the anus is of course pathognomonic of this presentation. The localisation of the sacrum is of considerable importance, for by it the *position* can be recognised. In the first and fourth positions it lies to the left, and either in front or behind respectively; in the second and third positions it lies to the right, and either in front or behind respectively. The diagnosis of position in breech presentations is not so important as in presentations of the vertex or face.

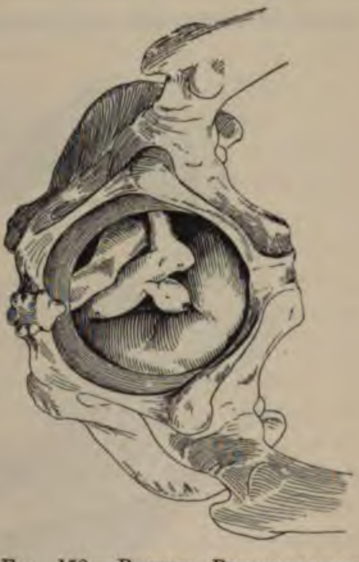


FIG. 150.—BREECH PRESENTATION: FIRST POSITION.
(RIBEMONT-DESSAIGNES AND LEPAGE.)
Patient in usual obstetric position.

The incomplete breech with extended legs is not easily recognised either by vaginal or abdominal examination when the presenting part is still in the pelvic brim; when the breech has passed into the pelvic cavity, the fact that the feet are not within reach of the fingers indicates this variety. The incomplete breech with extended thighs (knee or footling) is easily recognised on account of the small size of the presenting parts; the foot may be mistaken for the hand before rupture of the membranes, but afterwards the latter can be distinguished by the mobility of the thumb in all directions.

Mechanism.—The diameter of engagement is in all cases the bi-trochanteric or bis-iliac (both four inches), which enters the brim in one or other oblique diameter (four and three-quarter inches). It will be observed that the positions correspond, as regards the direction of the back of the fœtus, with those of the vertex and face.

During the process of labour a movement of *internal rotation* occurs, affecting successively the breech, the shoulders, and the head. As the breech descends, the bi-trochanteric diameter passes from the oblique of the brim (left in the first position) into the antero-posterior of the outlet, the anterior hip coming round under the symphysis pubis. The breech is then born by a movement of descent with lateral flexion of the spine around the pubes (fig. 151). The anterior hip is first disengaged; the posterior distends the perineum and follows it. At this stage the shoulders (bis-acromial diameter, four and three-quarter inches) engage in the same oblique diameter of the brim (left in the first position) as the breech,

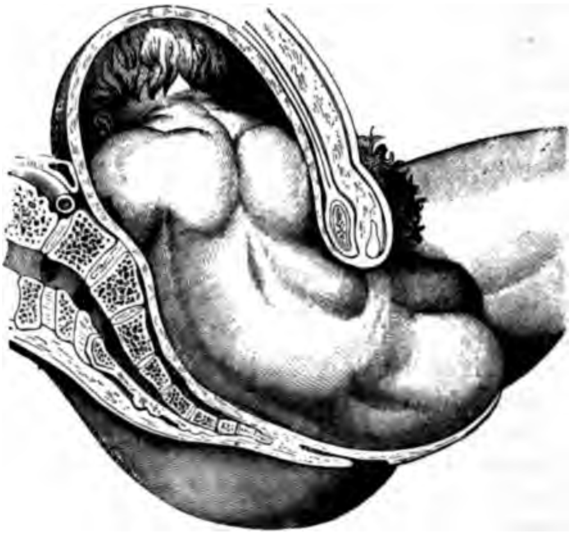


FIG. 151.—BIRTH OF THE HIPS IN BREECH PRESENTATION, SHOWING LATERAL FLEXION OF THE SPINE.

and in passing through the cavity internal rotation occurs, bringing the anterior shoulder under the symphysis pubis; the trunk is born with the arms folded across the chest. While the hips lie in the antero-posterior diameter of the outlet, and the shoulders lie at the same time in the oblique diameter of the brim, a slight amount of rotation of the dorsal spine must of course occur. The head should enter the brim fully flexed, while the shoulders are passing through the outlet; the sub-occipito-bregmatic diameter will then correspond with the right oblique, and forward rotation of the occiput follows, the anterior shoulder turning to the right side of the mother (first position). The head now lies with the nape of the neck behind the pubes, the forehead in the sacral hollow, and the face upon the pelvic floor; it becomes disengaged by the chin, face, and forehead successively passing over the perineum, thus maintaining the flexed position to the end. Backward rotation of the occiput is practically unknown in breech labour except when the fœtus is very small, or as the result of extension of the head from some kind of interference, or from want of pelvic space. In the posterior positions of the breech (third and fourth) the mechanism of labour differs little from that of the anterior positions (first and second). Owing to the apposition of the vertebral column of the fœtus to the maternal spine, the attitude of flexion is more difficult to maintain, and the occurrence of extension of the after-coming head is therefore more frequent. Internal rotation of the head is a long movement (three-eighths of a circle) as the head enters the brim with the occiput posterior; if, however, flexion is complete, little difficulty is to be anticipated from the greater length of this movement.

Owing to their greater size, the delivery of the shoulders is more difficult than that of the breech; the delivery of the head is more difficult than either, not because of the length of its diameters, but because it is less compressible than the breech or the shoulders, and because there is no time for moulding to occur.

The head is but little altered by breech labour. Of course no *caput* forms upon it, and there is practically no moulding. The general shape is therefore distinctly more globular than after a vertex presentation.

Anomalies in the Mechanism.—(1) Premature rupture of the membranes, with consequent loss of the dilating effect of the bag of waters, frequently occurs. (2) Extension of the legs may occur, either before labour as an abnormal attitude, or during labour from some obstacle to the descent of the complete breech. A breech labour is usually prolonged and difficult when extension of the legs occurs. The usual explanation of this is that the lower limbs in this attitude act as splints to the trunk, and thus interfere with the lateriflexion of the spine which occurs during the passage of the breech through the pelvic outlet. Not infrequently, however, the breech is delayed at the pelvic brim by this abnormality, which appears in some way to hinder the proper engagement of the bi-trochanteric diameter in the brim. (3) One or both arms may become displaced (extended) during the passage of the trunk through the pelvis; the displaced limb then lies either at the side of, behind, or in front of the head, and forms an insuperable obstacle to spontaneous delivery. (4) Non-rotation either of the shoulders or of the head may also occur, and delivery in the oblique diameter of the outlet will then be very difficult. (5) Finally, backward rotation of the occiput may occur spontaneously with a very small fœtus. Disengagement is then possible in one of two ways: if the head is completely flexed, the face, forehead, and vertex will pass successively under the symphysis; if extended, the chin becomes fixed against the pubes, the occiput is disengaged first, and is followed successively by the vertex and face, the chin coming last of all.

Prognosis.—The duration of labour is somewhat longer in breech than in vertex presentations, especially in primiparæ; this involves in itself a slightly increased risk to both mother and child. Unless artificial aid in extraction is required, the maternal risks are not otherwise increased; interference of course increases the risks both of laceration and of sepsis.

The risks to the child are, however, decidedly greater than in vertex cases, and recent statistics estimate the fœtal mortality in labour at 1–9 (primiparæ) to 1–30 (multiparæ). Older statistics might be quoted in which the fœtal mortality was about 25 per cent. In addition many infants born alive succumb within forty-eight hours to injuries received during labour. Certain fœtal risks are unavoidable, such as (*a*) compression of the cord during delivery of the head, (*b*) premature attempts at respiration from stimulation of the respiratory centre before the head is born. In addition it has been shown by Spencer that serious injuries to the abdominal and thoracic viscera from compression of the trunk may often be found on post-mortem examination of infants that have died during or soon after breech delivery. And further, from traction on the limbs and shoulders, rupture of muscular fibres, fracture of bones, and injury to nerve trunks may occur. Such accidents as prolapse of the cord or premature rupture of the membranes are frequently met with, and further increase the risks to the child.

Management.—When a breech presentation is discovered during the last four weeks of pregnancy, or very early in labour, it may be converted into a vertex by *external version* (p. 494); this should always be done if the patient is a primigravida, or if the pelvis is small and of the generally contracted type (p. 300). In a multipara with a normal pelvis, correction of the presentation is not of such great importance, but should be performed in the interests of the child.

During the *first* stage of labour especial care is necessary to preserve the bag of waters; when this has ruptured, an examination should immediately be made to confirm diagnosis and to look out for prolapse of the cord. In the *second* stage, untimely interference, such as extraction of the breech before the cervix is fully dilated, will lead to great difficulty in extracting the head. It is therefore of special importance to avoid interfering too soon. Nothing whatever should be done, when labour progresses favourably, until the buttocks have been completely expelled from the vulva. The work of the medical attendant then begins, and the survival of the child will often depend upon his knowledge of what is required, and of how to do it. The legs should be gently disengaged by extending first one and then the other with the fingers passed into the vagina. The exposed parts must be wrapped up in a warm towel and carefully protected during the remainder of the labour, in order to avoid the risk that cutaneous stimulation by cold air may excite the respiratory centre. The umbilical cord should be sought for and a loop pulled down so that its pulsation may be watched during the remaining stages.

Traction on the legs is not required at this period, and the temptation to pull must be steadily resisted, for it is obvious that traction will tend to produce extension of the head, because the vertebral column joins the head nearer the occiput than the sinciput. But the descent of the trunk may be aided by pressure with the hand on the fundus during the pains; fundal pressure is also useful in maintaining the flexed attitude of the arms and head. The trunk will be observed to rotate as the shoulders pass into the antero-posterior diameter of the outlet, the direction of rotation being from right to left in the first position. If the normal attitude of the arms has been preserved, the elbows will then appear

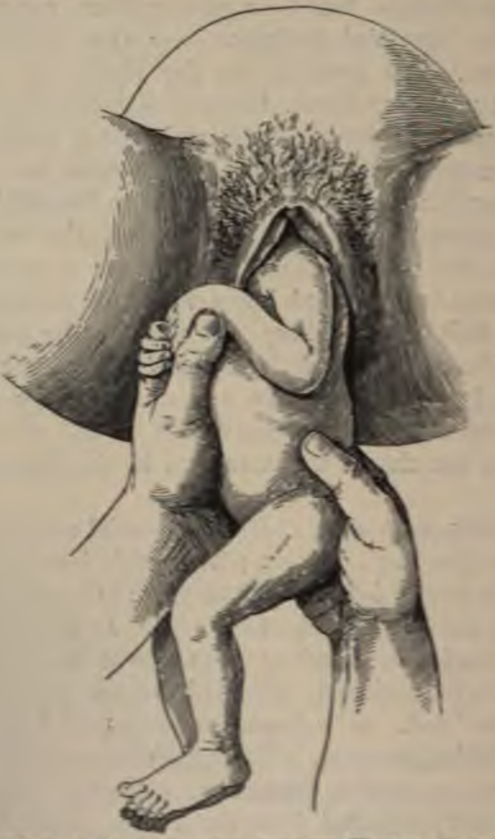


FIG. 152.—BREECH PRESENTATION, SHOWING HOW TO HOLD THE BODY OF THE CHILD. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Note.—The body should be wrapped up to protect it from cold air.

closely pressed against the chest. In holding the child at this stage, the hand should grasp the pelvis, not the waist (fig. 152), lest injury should be done to the abdominal viscera. When the child is small the head may be spontaneously disengaged by a voluntary effort of the mother; more often, however, assistance is required. The simplest method is to grasp the legs and carry the trunk of the child forwards parallel with the mother's abdominal wall, at the same time making pressure on the head in the axis of the pelvic brim (downwards and backwards) with the hand on the fundus. Frequently, however, this simple manœuvre does not suffice, and as the fœtal circulation is at this stage necessarily interfered with by compression of the cord or the placenta, prompt measures should be taken to deliver the head. The best method to adopt is that of Mauriceau or Veit—the credit of it is claimed for both (figs. 153 and 154). The trunk of the child, with the legs astride, is taken upon the right forearm, the index finger having been passed up to the face and inserted into the

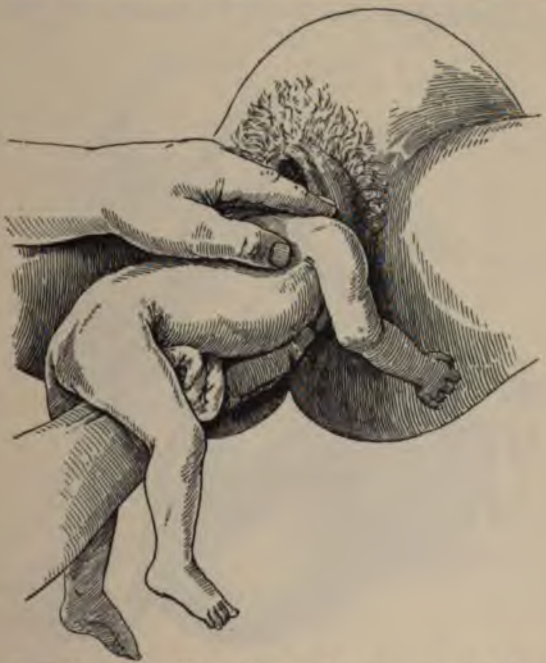


FIG. 153.—THE MAURICEAU-VEIT GRIP IN DELIVERING THE AFTER-COMING HEAD. FIRST STAGE. (RIBEMONT-DESSAIGNES AND LEPAGE.)

mouth in order to make traction upon the lower jaw. The left hand is placed upon the shoulders, the neck lying between the index and middle fingers. Traction is then made with both hands in the direction of the axis of that part of the pelvic cavity in which the head is lying. Flexion is maintained or extension corrected by the finger in the mouth, and descent may be aided by an assistant making pressure on the fundus. When the head reaches the outlet, the direction of traction must of course be changed (fig. 154), and is now applied chiefly to the shoulders, the lower hand merely maintaining the flexion of head.

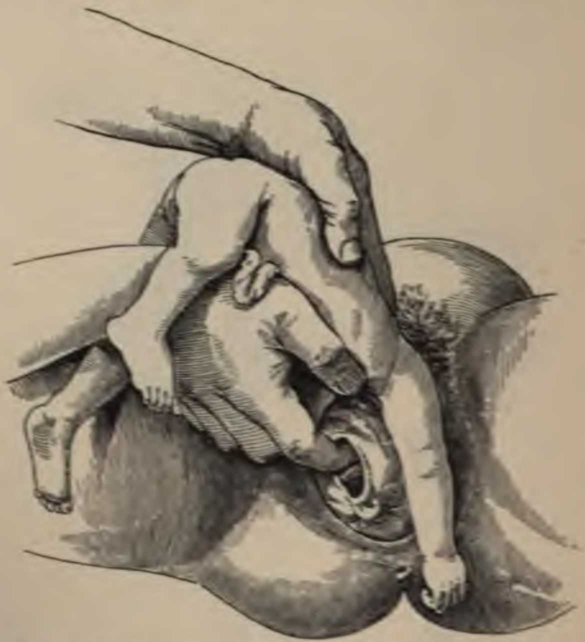


FIG. 154.—THE MAURICEAU-VEIT GRIP. SECOND STAGE. (RIBEMONT-DESSAIGNES AND LEPAGE.)

The grip of the head thus obtained is very effective; it is in reality a combination of two grips which were formerly practised separately, the anterior grip or jaw-traction being named after Smellie (Smellie grip), and the posterior grip after the great midwifery school of Prague (Prague grip). Time is, however, saved by employing them in combination, and success at this stage depends mainly upon the prompt application of effective methods. In the figures, the manœuvre is shown with the patient in the dorsal position; it can be equally well performed with the patient lying upon the left side, when the hands may be reversed.

If the head cannot be delivered in this way, the forceps should at once be applied. The child cannot survive compression of the cord for more than five to ten minutes, therefore forceps should always be got ready for use before commencing the delivery of the after-coming head.

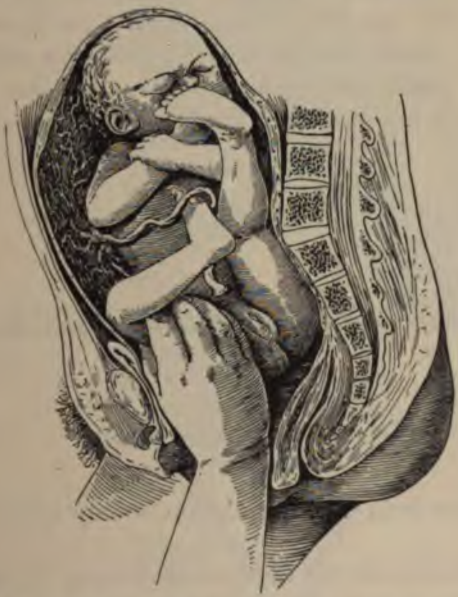


FIG. 155.—BREECH PRESENTATION. BRINGING DOWN A LEG. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Difficulties may arise during a breech labour at three different stages: (1) in the delivery of the buttocks, (2) in the delivery of the arms, (3) in the delivery of the head.

(1) The birth of the *buttocks* may be delayed (*a*) by uterine inertia, (*b*) by the large size of the fœtus or the insufficient size of the pelvis, (*c*) by extension of the legs.

The safest and surest mode of dealing with this difficulty, no matter how it may be caused, is to bring down a leg; it is the best method whether the buttocks lie at the pelvic brim or in the cavity. An anæsthetic is required for this procedure, and the entire hand is then passed into the vagina, strict antiseptic precautions being observed. The fingers then follow the anterior thigh up to the back and inner side of the knee, and pressure is made upon the limb at this point so as to abduct it; this will flex the leg and bring the foot down within reach, so that it can be seized and drawn down into the vagina (fig. 155). The same precautions must be observed in this manœuvre as in the operation of internal version (see p. 496). A loop of the cord may come down with the leg; it must be carefully replaced, well above the level of the buttocks. The expulsion of the child should now be left to the natural efforts, unless, from interference with the fœtal circulation, rapid delivery is necessary. In cases where this manœuvre is practised for uterine inertia, good pains will usually follow from the stimulation set up by the manipulations.

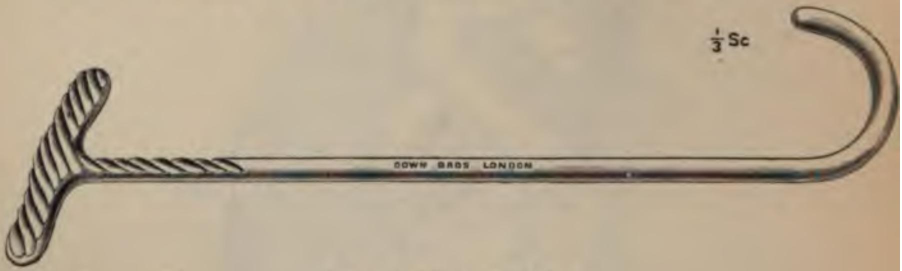


Fig. 156.—Breech Hook.

When the breech lies in the pelvic cavity it may be found that the leg cannot be reached on account of the large size of the child or the small size of the pelvis; traction must then be directly applied to the buttocks. The most effectual method of traction is by means of the Breech Hook (fig. 156). This is a blunt-pointed metal hook, the width of which should be at least two and a-quarter inches. It is applied by passing it over the lateral aspect of the anterior buttock until the point lies above the level of the fold of the groin; the instrument is then rotated through a right angle so as to bring the hook across the child's abdomen; a finger is then passed between the thighs, and the point of the hook carefully guided into position on the inner aspect of the anterior thigh. Traction can then be applied in the fold of the groin, and if care and gentleness are exercised there is little fear of injury occurring. Fracture of the femur or pelvis, or dislocation of the hip may, however, occur if great force is applied; therefore every effort should always be made to effect delivery by the previous method, unless the child is dead, when there is no objection whatever to the use of the breech hook. It is usually waste of time to attempt to apply traction to the breech with the fingers or the fillet.

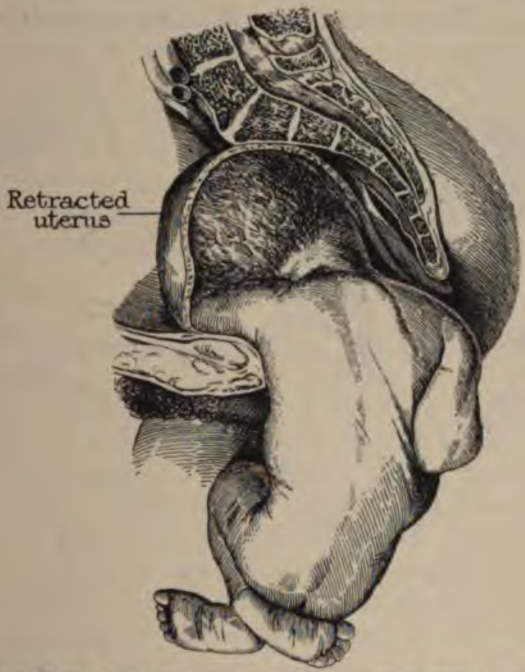


FIG. 157.—LATERAL DISPLACEMENT OF THE ANTERIOR ARM; THE POSTERIOR ARM HAS BEEN ALREADY BROUGHT DOWN.

(2) Difficulty in the delivery of the *arms* results from their becoming displaced; this is usually due to traction upwards having been applied in delivering the buttocks, but it may also be due to disproportion between the size of the fœtus and the pelvis. The displacement is usually lateral (extension) as shown in fig. 157. The shoulders will then probably lie in the oblique diameter of the brim; therefore one arm will be anterior, the other posterior. On account of the curvature of the sacrum, the posterior arm will be easier to reach than the anterior; it should therefore be delivered first. The hand

must be passed along the back of the child deep into the vagina, and the thumb and first two fingers carried over the humerus until the elbow is reached; the forearm can then be flexed over the face and chest, and the limb thus delivered. The anterior arm is next similarly dealt with. In a difficult case the trunk should be rotated into the transverse diameter, where there is more room for the necessary manipulations. An anæsthetic is usually required for this manœuvre. There is no risk of injuring the limb if traction is applied to the elbow or the forearm. Occasionally one arm becomes displaced laterally, the other flexed behind the occiput. The extended arm should first be delivered; next the pelvis should be seized and the trunk rotated to the side opposite the limb behind the occiput; this will bring the posterior arm into a lateral position, where it can be reached and delivered in the usual manner.

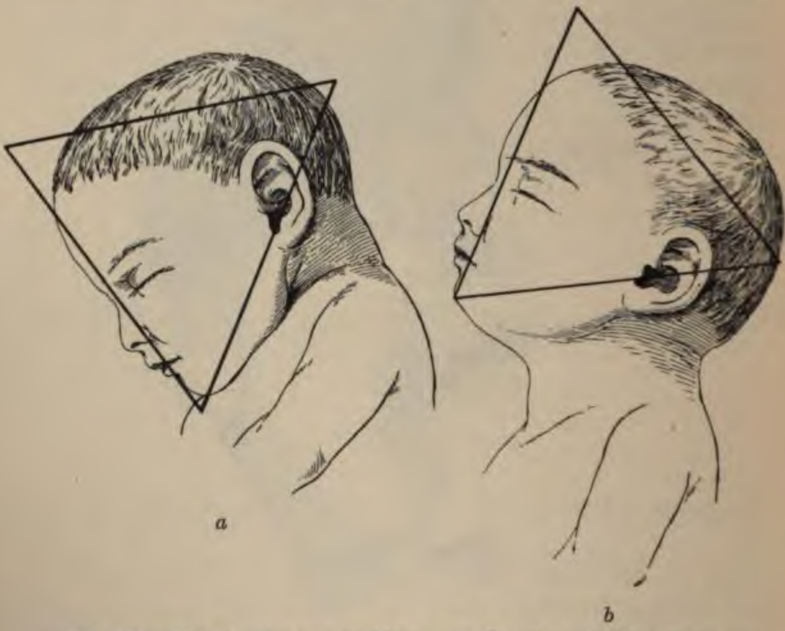


FIG. 158.—THE AFTER-COMING HEAD. *a.* FLEXED. *b.* EXTENDED.

(3) Difficulty in delivering the *head* results either from extension, from backward rotation, from its large size, or from contraction of the pelvis. The mechanical disadvantage

of extension of the after-coming head is indicated in fig. 158. When flexed, the head forms a wedge the apex of which is directed downwards; when extended, the base of the wedge is directed downwards, and descent is therefore much more difficult. In addition, the occipito-mental diameter (four and a-half inches) engages instead of the sub-occipito-frontal (four inches). If the extended head, when delayed at the brim, cannot be flexed by traction on the lower jaw combined with pressure on the fundus, perforation will probably be required. When the head is in the cavity, axis-traction forceps may succeed in effecting its delivery if of small size. Whenever the child is dead perforation should be performed without hesitation to secure easy delivery. If backward rotation has occurred, an attempt should be made to rotate the head and trunk so as to bring the occiput forwards; should this fail, perforation will be required unless the head is very small (see p. 260).

Transverse or Shoulder Presentations

These presentations include all cases in which the long axis of the fœtus lies more or less directly across the long axis of the uterus—*i.e.* all varieties of the transverse or oblique *lie*. Some part of the trunk of the fœtus presents—almost invariably by its lateral aspect. The shoulder (acromion process) in most instances forms the denominator of the presentation; but sometimes the arm becomes prolapsed and descends first into the vagina, while at other times the lateral aspect of the abdomen, or even the back, forms the actual presenting part.

It is usual to describe only two positions of the shoulder presentation, *dorso-anterior* and *dorso-posterior*; the former is much commoner than the latter because the fœtus accommodates itself better in that position to the forward curvature of the lower dorsal and lumbar vertebræ. In the former the normal fœtal attitude of flexion is fairly well preserved (fig. 159*a*); in the latter the spine becomes extended and displacement of the limbs is frequently met with (fig. 159*b*); premature rupture of membranes and prolapse of the cord are common in both positions. The head usually occupies the iliac fossa, the breech lying upon the opposite side at a somewhat higher level, so that the long axis of the fœtus is, strictly speaking, not transverse but oblique. More rarely the breech occupies the iliac fossa, while the head lies at the higher level.

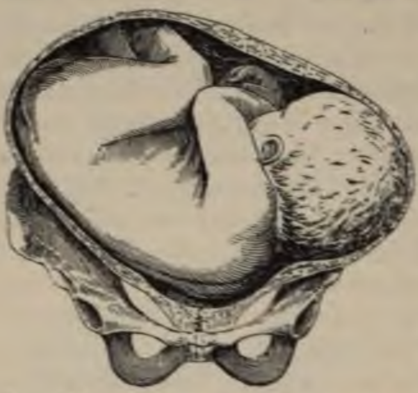


FIG. 159*a*. — SHOULDER PRESENTATION: DORSO-ANTERIOR POSITION. (RIBEMONT-DESSAIGNES AND LEPAGE.)

The general attitude of flexion is preserved.

Occurrence.—Shoulder presentations are rare, their frequency being variously estimated at from 1–125 to 1–250 labours. When premature labours are excluded the rate of frequency is much reduced. They are five or six times more frequent in multiparæ than in primigravidæ.

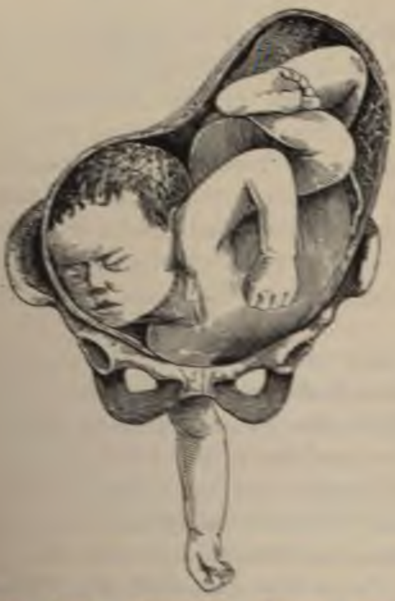


FIG. 159*b*. — SHOULDER PRESENTATION: DORSO-POSTERIOR POSITION. (RIBEMONT-DESSAIGNES AND LEPAGE.)

The spine is extended and the limbs are displaced.

Causes. — All conditions which prevent the ready descent of the fœtal head into the pelvic brim may occasion a shoulder presentation—*e.g.* pelvic contraction, hydramnios, placenta prævia, twins, extreme uterine obliquity, laxity of the uterine and abdominal muscles, premature or dead fœtus, &c. It will be recollected that the same conditions may cause other forms of abnormal presentation. The relative frequency of this presentation in multiparæ is probably to be explained by permanent weakening of the abdominal muscles, permitting forward or extreme lateral displacement of the uterus to occur.

Diagnosis.—This presentation can easily be recognised by abdominal palpation, *before labour has commenced*, or *early in the first stage* when the membranes are intact. The uterus is not pyramidal in shape, but irregular, the long axis lying more or less completely across the abdomen; as the presenting part cannot descend into the brim the level of the fundus is unaltered. Systematic palpation will show that the head occupies one or other iliac fossa, and usually that the back is anterior; the soft bulky breech will then be found on the opposite side and at a higher level than the head; occasionally, however, the breech will be found in the iliac fossa. Auscultation of the fœtal heart does not assist the diagnosis of this presentation.

Nothing can be made out on vaginal examination before labour, except that the presenting part lies high up and is soft to the touch. During the first stage a large and elongated bag of waters will form, in which a small part—the arm—may be felt; if the membranes have ruptured, the arm may become prolapsed early in labour.

Later on in labour, when the liquor amnii has escaped and the uterus has become moulded around the body of the fœtus, detailed abdominal palpation is very difficult, and the position of the different parts of the fœtus cannot in this way be made out. Diagnosis must then be made by *vaginal examination*. A prolapsed arm will of course settle the presentation at once, and the position of the head and back can be deduced from the relation of the hand when supinated: the thumb pointing to the head, the palm corresponding to the ventral aspect. When prolapse of the arm does not occur, diagnosis will be more difficult. In almost all cases, however, the ribs with their intercostal spaces or the vertebral spines can be recognised with the finger, which usually reaches the former along the posterior

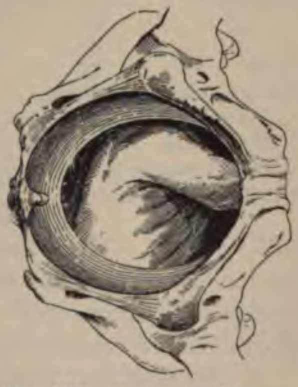


FIG. 160.—SHOULDER PRESENTATION: DORSO-POSTERIOR POSITION. (RIBEMONT-DESSAIGNES AND LEPAGE.) Patient in usual obstetric position.

axillary border (fig. 160); these parts can hardly be mistaken for anything else. The angle of the scapula may also be recognised, and is useful as indicating the position of the back. The acromion process and the curved clavicle may also sometimes be identified. By passing the exploring finger towards the right or left side of the mother, the finger can be passed into the pit formed by the apex of the axilla; the head, of course, lies upon the same side of the pelvis as the axillary pit.

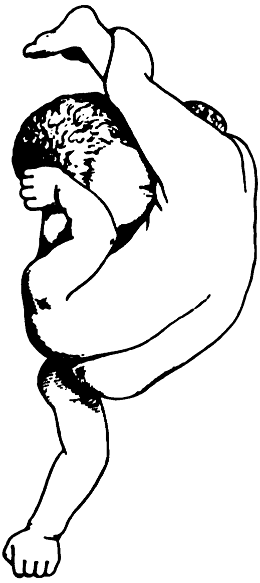


FIG. 161.—ATTITUDE OF THE FŒTUS IN SPONTANEOUS EVOLUTION. FROM NATURE. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Mechanism.—Natural delivery in a shoulder presentation is impossible when the fœtus is full-sized; under exceptional circumstances, however, it may take place in one of the following three ways:

A. *Spontaneous version* may occur—*i.e.* the presentation may spontaneously become transformed into a breech or a vertex. This occurrence has been observed early in labour, before the membranes have ruptured or the presenting part has become engaged. It was first described by an English obstetrician of the eighteenth century named Denman. The term 'spontaneous version' is usually applied only to the transformation of a shoulder into a breech presentation; when transformed into a vertex the process is called *spontaneous rectification.* This is an unnecessary distinction, since version may be either cephalic or pelvic (see p. 494). No precise observations have been made upon the mechanism of spontaneous version; its occurrence is no doubt very rare.

B. *Spontaneous evolution* may occur when the fœtus is small or macerated, the pelvis large, and the uterine contractions powerful. This process, first described by a Dublin obstetrician, Douglas (beginning of nineteenth century), has recently been studied by Ribemont-Dessaignes, who was able to obtain photographs of the different stages of delivery. The attitude assumed by the fœtus is shown in fig. 161; extreme flexion of the head and the cervical spine occurs, causing severe compression of the thoracic and abdominal viscera; and even if the fœtus is alive at the onset of labour, death invariably occurs during delivery. Prolapse of the posterior arm first takes place, and the head and trunk then become compressed by the uterine contractions into the smallest possible bulk. After the expulsion of the prolapsed arm and shoulder (fig. 162) the anterior shoulder appears under the symphysis, and the back follows, being expelled in the oblique diameter of the outlet. As the disengagement of the trunk proceeds, a movement of rotation occurs, carrying it into the transverse diameter, the head being on one side, the breech on the other (fig. 163). Forward rotation of the shoulders next takes place, bringing the neck under the symphysis pubis, and the legs become disengaged in the antero-posterior diameter (fig. 164). Labour terminates like

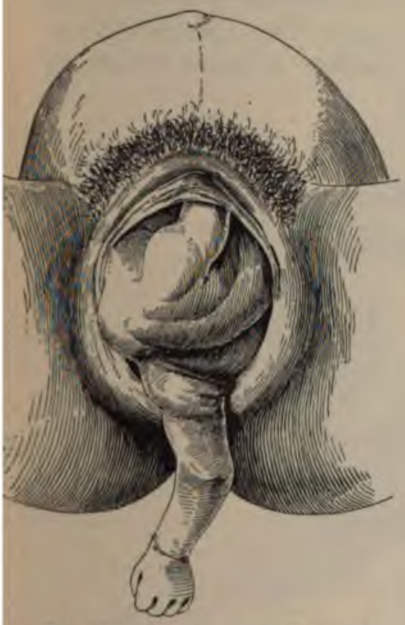


Fig. 162.—Spontaneous Evolution, Photographed from Nature. First Stage of Delivery, showing Prolapse of Posterior Arm.

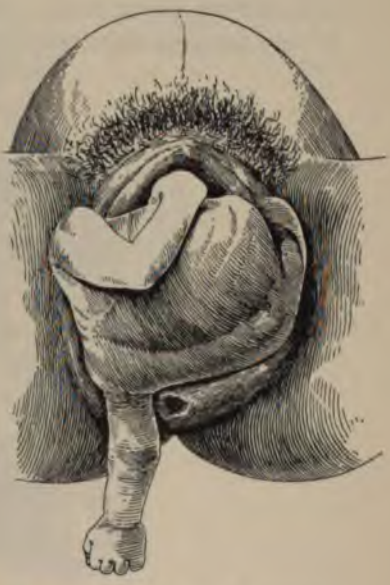


Fig. 163.—Spontaneous Evolution. Second Stage, showing Delivery of Back in the Transverse Diameter.

(Ribemont-Dessaignes and Lepage.)

a breech case with the delivery of the after-coming head. The fœtus represented in these figures (photographed from nature) weighed five and a-half pounds.

C. *Spontaneous expulsion* is also described as a possible termination in the case of a macerated fœtus. From the accounts of observers who have watched the process, it is clear that it does not differ in any important respect from spontaneous evolution, and scarcely deserves to be recognised as distinct from the latter. The trunk of the macerated fœtus is very compressible, and may therefore be more completely bent upon itself, allowing the head and breech to be disengaged together (fig. 165).

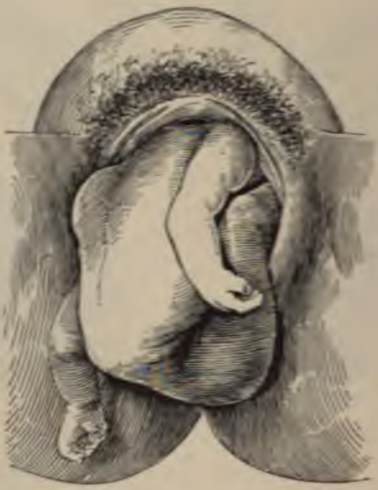


FIG. 164.—SPONTANEOUS EVOLUTION. THIRD STAGE, SHOWING FORWARD ROTATION OF SHOULDERS AND DELIVERY OF LEGS. (RIBEMONT-DESSAIGNES AND LEPAGE.)

It must be clearly understood that these natural terminations of shoulder presentations are exceptional occurrences, and cannot under any circumstances be awaited. This presentation must invariably be dealt with by immediate interference in the manner indicated below. If allowed to continue, the case will in all probability become one of *obstructed labour*; over-distension of the lower uterine segment will ensue (see p. 332), the child will die of compression, and the mother, unless rescued by operative measures, will die undelivered, either of exhaustion or of rupture of the uterus.

Management.—Since it is impossible, under ordinary conditions, for natural delivery to take place in shoulder presentations, the treatment consists, in all circumstances, in converting the presentation into a vertex or a breech by one of the methods of version (p. 494). These methods will be described in connection with the obstetric operations. If abdominal examination is practised during the latter weeks of pregnancy, shoulder presentations may be discovered before the onset of labour, and at this time they can be corrected by external version with ease and with perfect safety both to the mother and the fœtus. If the pelvis is of normal size, cephalic version should be practised. The mal-presentation is however apt to recur, as will be readily understood if

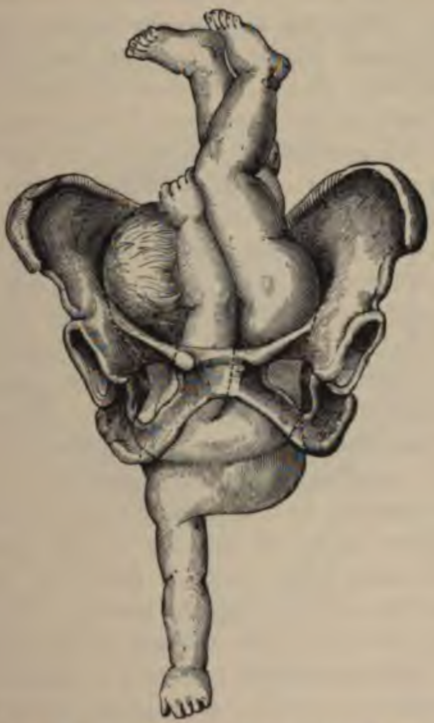


FIG. 165.—TRANSVERSE PRESENTATION.
DELIVERY BY SPONTANEOUS EXPULSION. (KLEINWÄCHTER.)

its causes are borne in mind. After correction of a shoulder presentation in pregnancy the patient should accordingly be examined every few days until labour begins. When the diagnosis is made early in labour, and the membranes are intact, the mal-presentation can be corrected either by external or bi-polar version. At this stage it is better to perform podalic version, rupture the membranes, and bring down a foot into the vagina, so as permanently to correct the mal-presentation. When the membranes rupture prematurely—either before labour sets in or early in the first stage, difficulty may be met with (1) from want of space for turning, if the greater part of the liquor amnii has escaped; (2) from prolapse of the arm or of a loop of the umbilical cord; (3) from the undilated condition of the cervix. Under these circumstances the best treatment is first carefully to return the prolapsed cord or arm under anæsthesia, and then to introduce a Champetier bag into the uterus. When the cervix has been dilated by the bag, internal version may be performed if the condition of the uterus allows of this being safely done (p. 496). Sometimes shoulder presentations are not seen until labour is advanced, the liquor amnii has all escaped, and the uterus is retracted over the fœtus, or is actually in a state of over-distension; the presenting part will then be found to be immovably fixed in the pelvis, and the premonitory signs of rupture of the uterus may be present. In such cases version must not be attempted, owing to the risk of rupturing the uterus. The fœtus is invariably dead, and only the welfare of the mother need be considered. Delivery should therefore be effected by decapitation or evisceration (p. 53). In general, if the fœtus is dead decapitation should always be preferred to version, unless the conditions allow of the latter being easily and safely performed.

Twin Labour

The diagnosis of twin pregnancy has been considered on page 69.

Presentation.—The two fœtuses are almost invariably placed side by side in the uterus, the *lie* being longitudinal;

more rarely one is placed entirely above the other. The commonest presentations are the following :

First child vertex, Second child vertex		33 %
First ,, vertex, Second ,, breech		25 %
First ,, breech, Second ,, vertex		12 %
First ,, breech, Second ,, breech		10 %
First ,, vertex or breech, Second child shoulder		2 %
		82 %

The remaining 18 per cent. are made up of various combinations. The presentation of the second fœtus can seldom be recognised until the first has been born, or at any rate until labour has considerably advanced.

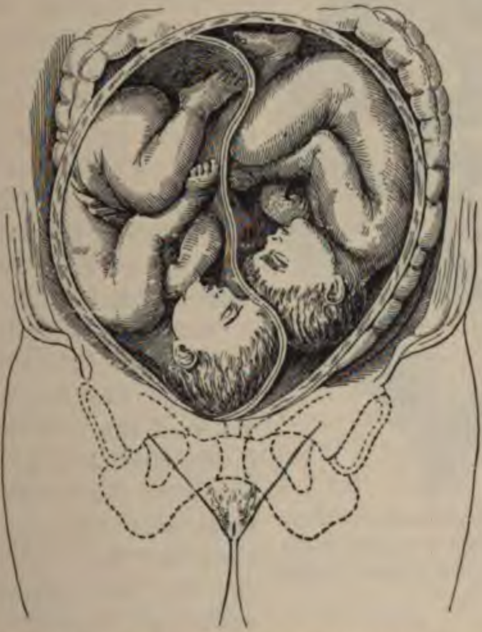


Fig. 166.—Twin Labour ; both Fœtuses presenting by the Vertex.

General Course of Labour.—With twins, labour frequently comes on prematurely, and shows an increased liability to the occurrence of certain complications, such as (*a*) hydramnios (usually affecting one sac only), (*b*) premature rupture of the membranes, (*c*) prolapse of a loop of the cord or a limb, (*d*) uterine inertia, (*e*) complex presentations. As a consequence, twin labour is usually somewhat prolonged; this is due partly to weakness of the over-distended uterine wall, which results in primary inertia (see p. 320), and partly to the fact that the stage of expulsion is duplicated. These disadvantages are to some extent counterbalanced by the small size of twin fœtuses. In other respects the course of labour depends entirely upon the relation of the fœtuses to one another. When the pelvis is full-sized or unusually large, the small first fœtus does not fill it, and the presenting part of the second may enter the brim simultaneously with the first; the passage of both will thus become obstructed: this is known as *twin locking*. The following are the principal varieties: (1) two vertex presentations; one head lying in advance of the other, the vertex of the second enters the brim together with the neck of the first, and neither can make progress; (2) first breech, second vertex presentation; the vertex of the second enters the brim in advance of the after-coming head of the first, and the two heads become locked either *chin to chin*, *side by side*, *occiput to chin*, or *occiput to occiput*; (3) the first presents by the vertex or breech, the second transversely. In varieties (1) and (2), natural delivery is possible if the pelvis is large, the uterine contractions are powerful, and the fœtuses are small; when these conditions are not present, and invariably in the third variety, insuperable obstruction to natural delivery will result. Locking occurs quite as frequently with binovular as with uniovular twins.

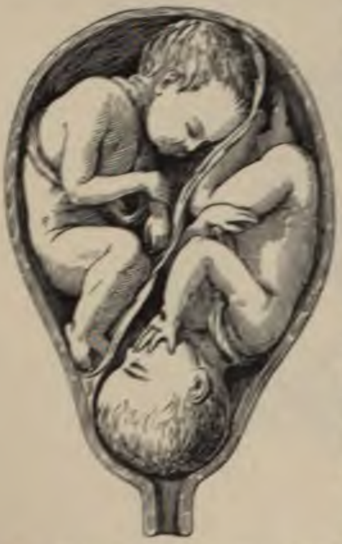


Fig. 167.—Twin Labour: First Fœtus presents by the Vertex. Second by the Breech (incomplete).

Management.—Since the first child almost invariably presents by the head or breech, its delivery may be left to the natural efforts. In some cases of binovular twins with independent placentæ, the first after-birth may immediately follow the delivery of the first child. Usually, however, this does not occur, and the uterine contractions cease for fifteen to thirty minutes after the birth of the first child; then they return, and the second, if presenting favourably, is quickly delivered, for the passages have been already fully dilated. A vaginal examination should be made immediately after the birth of the first child to recognise the presentation of the second; if vertex or breech, nothing need be done; if transverse, external or internal version should be performed; the latter will be usually very easy on account of the small size of the fœtus and the relaxed condition of the cervix. When the lie of the fœtus is longitudinal, the membranes may be ruptured artificially if the uterine contractions are ineffectual. Cases of binovular twins occasionally occur in which labour ceases after the birth of the first child; the cervix becomes smaller, the second bag of waters recedes, the uterus remains completely relaxed, and ten to twelve days, or even much longer periods, may elapse before the return of labour pains. In such circumstances it is better to excite pains by rupturing the membranes. The two placentæ usually follow the birth of the second child. The *third stage* should be conducted with the greatest care and patience; the uterus quickly becomes exhausted, and, the area of the placental site being unusually large, the risks of post-partum hæmorrhage are increased. When dividing the cord of the first child between two ligatures in the usual manner, care should be taken to tie the distal ligature securely, for if an anastomosis should exist between the two placental circulations (umbilical), the second child may bleed through the cord of the first.

Twin locking is dealt with by sacrificing the first child, which is usually dead, in the interests of the second, if the fœtal entanglement cannot be cleared by manipulation under anæsthesia. In the first variety, the lower head may be sometimes extracted after pushing up the upper head out of the way; if forceps fails, the head must be perforated and crushed. In the second and third varieties, the first fœtus will almost inevitably perish; it may be decapitated, or the head perforated, and after delivering it an attempt should be made to save the second by the application of forceps or by version.

Prolapse of the Umbilical Cord and the Limbs

A loop of the umbilical cord sometimes descends below the presenting part; when this occurs before the membranes have ruptured, the condition is called *presentation* of the cord. After rupture the loop will descend into the vagina or may even protrude at the vulva; this is *prolapse* of the cord.

Causes.—Descent of the cord is more likely to occur when the presenting part imperfectly fills the pelvic brim than when the conditions are normal; it is therefore chiefly met with in presentations of the breech or shoulder, when there is pelvic contraction, hydramnios, or twins, or when the fœtus is unusually small, as in premature labour; other conditions which favour its occurrence are placenta prævia, an abnormally long cord, and the lax condition of the uterus found in multiparæ.

Diagnosis.—The loop of cord is easily recognised whether the membranes are intact or ruptured. If the fœtus is dead and pulsation has ceased, *presentation* of the cord may be mistaken for a hand or foot, but with *prolapse* no mistake is possible.

Risks.—Prolapse of the cord does not increase the maternal risks of labour, except in so far as the manipulations required for its replacement involve slight additional risks of sepsis. The fœtus is in great danger of death by asphyxia from compression of the cord between the presenting part and the pelvic wall, or the lip of the imperfectly dilated cervix; the fœtal mortality in this condition is about 50 per cent. The risks are greater when the presentation is a vertex than in abnormal presentations, for serious compression can hardly be avoided when the head is in the brim. Descent in front of the head (anterior) is more dangerous than descent behind it (posterior), for in the latter the cord may lie near one of the sacro-iliac synchondroses and thus entirely escape compression, while in the former the loop is certain to be compressed between the head and the anterior pelvic wall. The risk is less in a multipara than in a primigravida, for in the former labour can be terminated more rapidly.

Management.—When it is found that pulsation in the cord has entirely ceased the fœtal heart should be auscultated, and, if no sounds are heard, the case may be left to terminate naturally, as the fœtus is dead. If compression of the cord has lasted but a short time, the heart may continue to beat. When the fœtus is still living interference in its interest is required.

Presentation of the cord is best treated by posture. The aim of postural management is to place the patient in an attitude in which the fundus of the uterus lies at a lower level than the cervix, so that the action of gravity will promote the return of the presenting loop into the uterine cavity. The most effectual method is to place the patient in the genu-pectoral position (fig. 168), in which the body is supported upon the knees and the upper part of the chest, the arms being folded beneath it. Another less effectual, but also less troublesome method, is the knee-elbow position, in which the body rests upon the knees and forearms (fig. 169). The knee-chest is more effectual than the knee-elbow position, because in the former the fundus lies at a relatively lower level than in the latter. Both of these postures are very irksome, and cannot be maintained for more than ten to fifteen minutes at a time; the patient should then be placed upon her side, and the postural treatment resumed after an interval. In hospital

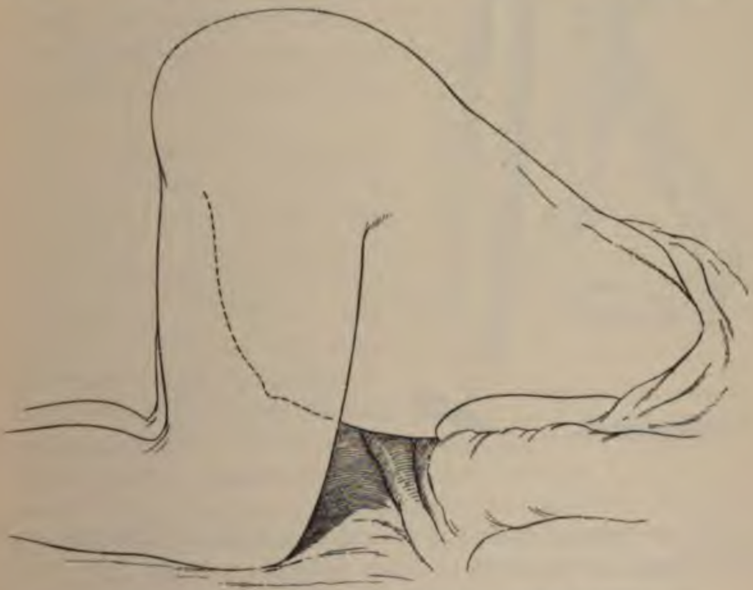


FIG. 168.—THE KNEE-CHEST (GENU-PECTORAL) POSITION.

practice the Trendelenburg position has been employed, and with a suitable table it is possible to obtain a posture in which the patient is nearly upside down; but it is obviously unsuitable for general use. These postures frequently fail to effect reduction. The greatest care should be taken to preserve the membranes, for while they remain intact there is little or no risk of compression. The possibility of pelvic contraction must be remembered, but no other treatment is required at this stage, as the fœtus is not in immediate danger.

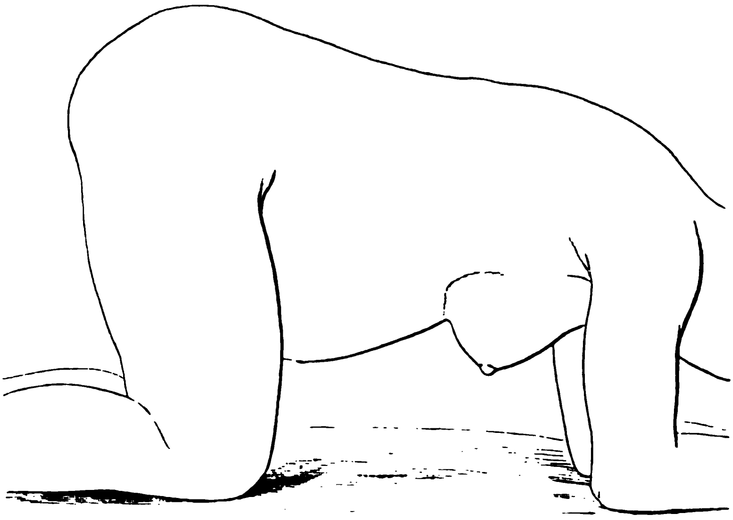


FIG. 169.—THE KNEE-ELBOW POSITION.

Prolapse of the cord with a *partially dilated cervix* should in the first instance be treated by *digital* reposition. An anæsthetic is administered, the whole hand passed into the vagina, and the cord then pushed into the uterus well above the presenting part. In vertex presentation a tight abdominal binder may then be applied, to keep the presenting part well down in the pelvic brim, and so prevent recurrence of the prolapse. With the same object, in breech presentation a leg should be pulled down into the vagina. *Instrumental* methods of reposition are also sometimes adopted, but they are inferior to the digital method, for by the former a portion of the loop may easily be left in a dangerous position, unknown to the operator. A simple repositor can be constructed from a piece of tape and a gum-elastic catheter (fig. 170). A suitable length of tape is boiled and passed through or around the prolapsed loop of cord; the catheter is sterilised and prepared by making a counter-opening opposite the eye; through this the ends of the tape are then threaded. The loop of tape encircling the prolapsed cord is now drawn sufficiently tight to hold it without undue compression. The catheter, along with the snared loop of cord, is next pushed up into the uterus as high as possible, and left there to be expelled with the body of the fœtus.

If in a vertex presentation with a partially dilated cervix reposition cannot be properly effected, or if the cord comes down again after having been replaced, a Champetier bag should be introduced after careful reposition of the prolapsed loop; this will effectually prevent recurrence, in addition to dilating the cervix. In a breech presentation the risk of compression is decidedly less. If the cord can be properly replaced, it is sufficient to pull down a leg and leave delivery to nature; if there is difficulty in replacing it, the dilating bag should be employed.

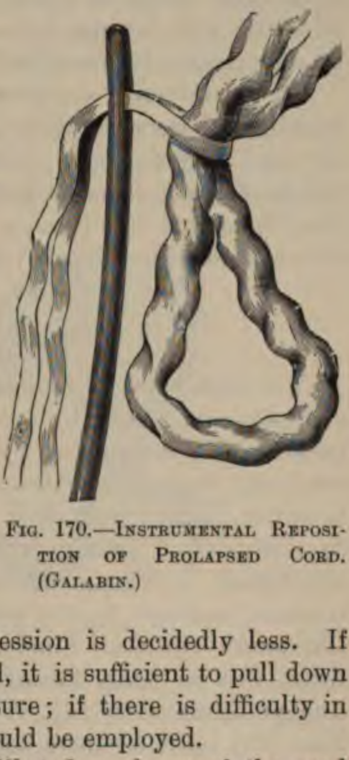


FIG. 170.—INSTRUMENTAL REPOSITION OF PROLAPSED CORD. (GALABIN.)

When the cervix is *fully dilated*, prolapse of the cord should in all cases be treated by immediate delivery by version or forceps. If the head has passed the brim, the cord cannot possibly be replaced nor can version be performed; rapid extraction with forceps offers the best chance of saving the child.

Prolapse of Limbs.—Very occasionally a vertex presentation is complicated by descent of the arm or the leg, so that the hand or foot enters the pelvic brim along with the head. This occurs more frequently with premature labour or with twins, or when the pelvis is contracted, than under normal conditions. Such a presentation is usually called *complex*.

Prolapse of the foot is much rarer than prolapse of the hand. When the head is of small size, prolapse of the hand does not prevent natural delivery; if, however, with a large head descent is interfered with, the hand should be replaced under anæsthesia, and the head then delivered with forceps. Even if the hand cannot be replaced, it will in all probability interfere little with forceps delivery, although it may be injured by compression between the forceps-blade and the pelvic wall.

In a transverse presentation both the arm and the leg sometimes become prolapsed, and along with them a loop of the cord may descend. This gives a complex presentation which offers considerable difficulties in diagnosis. The treatment is version in all cases, when the labour is not too far advanced for this operation to be safely performed.

Pelvic Contraction

The female pelvis may be variously altered in size alone, or in size and shape, by errors of development, by local or general bone disease, or by the results of accident. The frequency of pelvic contraction varies greatly in different localities, being much more frequent in large cities than in rural districts. Among over 50,000 labours in the University Klinik in Vienna between 1878 and 1895, pelvic contraction occurred in 2·5 per cent. of all cases. At Queen Charlotte's Hospital, London, in the years 1905–7, it was found that in 5,000 labours 4·6 per cent. of cases of contracted pelvis occurred. A large number of different types exist, but most of them are of rare occurrence, and their effects upon the course of labour have not received detailed individual study. Two types are, however, of comparatively frequent occurrence, and must therefore be fully considered; the others will be only briefly referred to.

1. **The Generally Contracted Pelvis** (Small round pelvis: Pelvis æquabiliter justo-minor).—This form of pelvis (fig. 171) differs from the normal mainly in size, all the diameters being *proportionately* diminished, while the general shape is preserved. Minor differences, however, exist in the inclination of the plane of the brim and in the curvature of the sacrum. The promontory lies at a level higher than normal; and the angle made by the plane of the brim with

the horizon is therefore somewhat increased. (Compare figs. 86 and 171.) The concavity of the sacrum from side to side is deepened, while that from above downwards is diminished; these changes slightly exaggerate the diminution of the antero-posterior diameter of the cavity. All the dimensions of the outlet are proportionately reduced. The shape of the false pelvis is unaffected, but its diameters are also diminished. Sometimes pelves of this variety approximating to the male type are met with.

Nothing is definitely known of the causes of this form of pelvic contraction; it is said to be the variety most commonly met with in America (Edgar), but in European countries the rachitic forms predominate. It may be met with in women whose development is otherwise normal; it is also frequently found in dwarfs who are not the subjects of rickets.

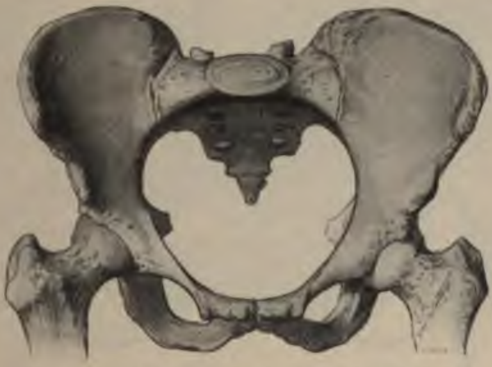


FIG. 171.—GENERALLY CONTRACTED PELVIS.

2. The Flat Pelvis.—The characteristic features of this form of contracted pelvis are: (1) reduction in length of the conjugate diameter of the brim, and (2) an abnormal curvature of the iliac crests. Two varieties are distinguished—viz. one in which no other changes than those just mentioned are found, and one in which changes also occur in the pelvic cavity and outlet. By some writers these varieties are respectively termed *non-rachitic* and *rachitic*, the latter being attributed to rickets in all cases. By others, both varieties are attributed to rickets, and they are then respectively termed the *elliptical* or *simple flat pelvis*, and the *reniform flat pelvis.* The latter is clearly rickety, but the evidence upon which the former is attributed to rickets is inconclusive, and we shall therefore adopt the names *non-rachitic* and *rachitic* flat pelvis for these two varieties.

In the *non-rachitic flat pelvis* the deformity is never extreme; the patient is usually well developed in other respects, and shows no rickety changes in any other part of the skeleton. The anterior portions of the iliac crests are not incurved to the same extent as in the normal pelvis; consequently the distance between the anterior superior iliac spines (*interspinous diameter*) does not maintain its usual proportion to the distance between the summits of the iliac crests (*intercristal diameter*). This alteration has no influence upon labour, but is useful clinically, in furnishing an indication of the condition of the pelvic brim. The conjugate diameter of the brim may be reduced to 3 inches (7·5 cm.), but in this form of flat pelvis it is very rare to find a greater reduction than this. This change, to which the characteristic *flattening* is due, appears to be caused by slight forward displacement of the upper part of the sacrum. The transverse diameter of the brim is increased, either absolutely (over five inches) or at any rate relatively to the length of the conjugate. The oblique diameters of the brim, as well as all those of the cavity and outlet, are unaltered.

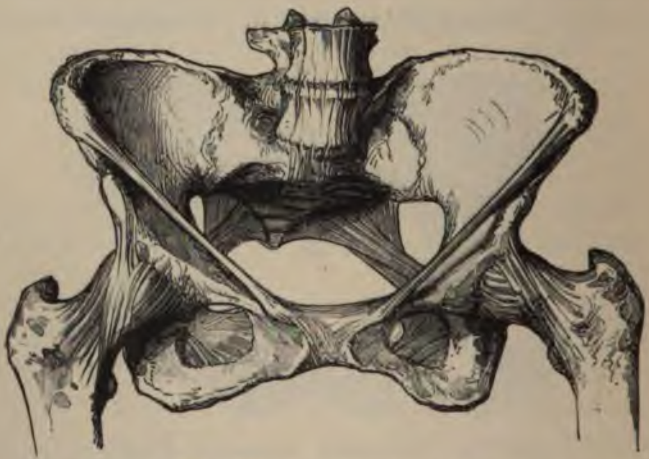


FIG. 172.—RACHITIC FLAT PELVIS, MINOR DEGREE: SHOWING REDUCTION OF THE CONJUGATE AND FLATTENING OF THE SACRUM.

In the *rachitic flat pelvis* the deformity may be, and usually is, much more pronounced than this. Such evidences of rickets will be found as curvature of the shafts of the long bones and enlargement of their epiphyses, beading and bending of the ribs, and, perhaps, diminutive stature. In marked cases the pelvis shows a series of characteristic changes. The outward displacement of the anterior portion of the iliac crests is well marked, the iliac fossæ being directed nearly forwards, instead of forwards and inwards. (Compare figs. 86 and 173.) The sacrum, softened by disease, has been both bent and displaced forwards by the pressure of the body-weight; the promontory has therefore been carried nearer to the symphysis, and the concave anterior surface has become flat, or it may be even slightly convex (figs. 174 and 175). In addition, rotation of the whole bone has occurred round a horizontal axis passing through the centre of the sacro-iliac synchondroses; this brings the promontory still nearer the symphysis, and carries the coccyx further away from it. The *outlet* of a rachitic flat pelvis, on the other hand, is larger than normal (fig. 174). Its antero-

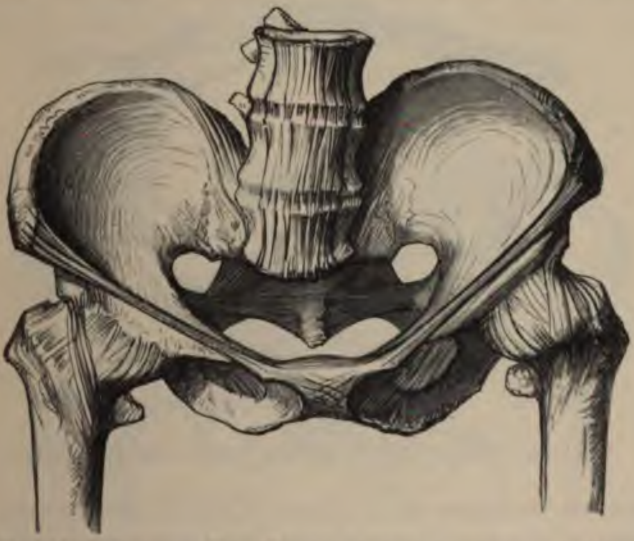


FIG. 173.—RACHITIC FLAT PELVIS, EXTREME DEGREE: ALTERED CURVATURE OF THE ILIAC CRESTS.

The relative increase in the transverse diameter is well shown.

posterior diameter is increased by the rotation of the sacrum just described. Under the pressure of the body-weight transmitted by the innominate bones through the hip-joints to the legs, the lateral pelvic walls bulge outwards, increasing the transverse diameter of the brim; while the ischial tuberosities are carried further apart, thus increasing the width of the pubic arch and the length of the transverse diameter of the outlet. On looking into such a pelvis from below, the large dimensions of the outlet contrast greatly with the contracted conjugate of the brim, while the exaggerated prominence of the sacral promontory is well seen (compare figs. 90 and 174).

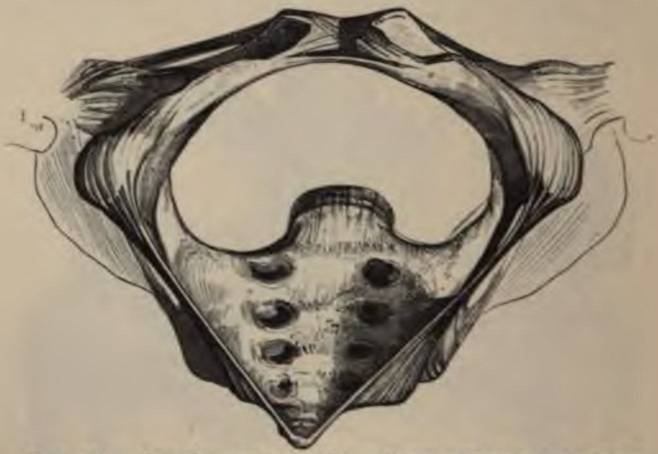


FIG. 174.—THE OUTLET OF A FLAT PELVIS SEEN FROM BELOW.

Sometimes in a rachitic flat pelvis the bodies of the pubic bones are distinctly incurved (beaked), encroaching still further upon the conjugate of the brim; when the latter deformity is well marked the pelvis is sometimes called, from the shape of the brim, the *figure-of-eight rachitic flat pelvis.*

The changes in a marked case of rachitic flat pelvis may be summarised as follows:

False Pelvis.—Relative increase in interspinous diameter.

Brim.—Conjugate diminished, transverse increased, shape reniform or figure-of-eight (see fig. 193).

Outlet.—Transverse and antero-posterior increased, pubic arch widened, or in some cases narrowed (beaked).

Cavity.—Anterior surface of sacrum flat or convex.

The generally contracted flat pelvis (flat justo-minor pelvis) is a form in which diminutive size is associated with rachitic flattening; the shape is that of the rachitic flat pelvis, but all the diameters are diminished in length. This form of pelvis is usually associated with extreme rachitic changes in the skeleton generally, one of the most frequent of these being lateral curvature of the spine (scoliosis). When this change is present the resulting pelvic contraction is asymmetrical or oblique (fig. 175). If the spine is fairly straight, the generally contracted flat pelvis remains symmetrical. The resulting deformity is, in either case, extreme, and gives rise to more serious difficulty in labour than either the flat pelvis or the small round pelvis.

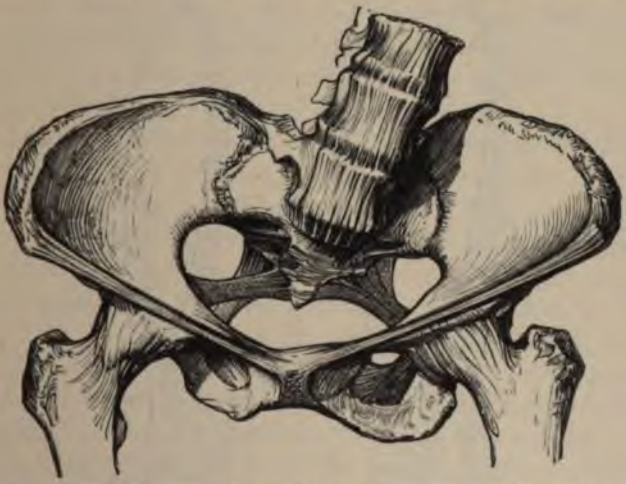


FIG. 175.—GENERALLY CONTRACTED FLAT PELVIS, WITH LATERAL OBLIQUITY DUE TO SCOLIOSIS (RACHITIC).

In the Vienna statistics already quoted, the four varieties of non-rachitic flat pelvis, rachitic flat pelvis, generally contracted pelvis, and generally contracted flat pelvis, accounted for about 96 per cent. of all cases of pelvic contraction; the remaining varieties are accordingly very uncommon. The extreme cases of pelvic contraction met with in this country usually belong to the generally contracted flat variety.

Generally enlarged Pelvis (pelvis æquabiliter justo-major).—This is not a *contracted* pelvis at all, but a pelvis of greater size than the normal, though proportionate in all its diameters. Its influence is not, as a rule, unfavourable, but it may be one of the factors in the causation of *precipitate labour* (see p. 320).

Diagnosis of Pelvic Contraction.—While the presence of a contracted pelvis may be surmised from the diminutive stature of the patient, from general evidences of rickets or other bone diseases, from lameness, or from the pendulous condition of the abdomen in pregnancy, it can only be certainly recognised by measurement. The anatomical pelvic diameters described on page 176 cannot be measured clinically, but certain other measurements of the living subject can be made, from which the size of the true pelvis may be inferred with approximate accuracy. Such measurements must be made with great care, as it is very important for practical purposes to note the degree of contraction present in any given case.

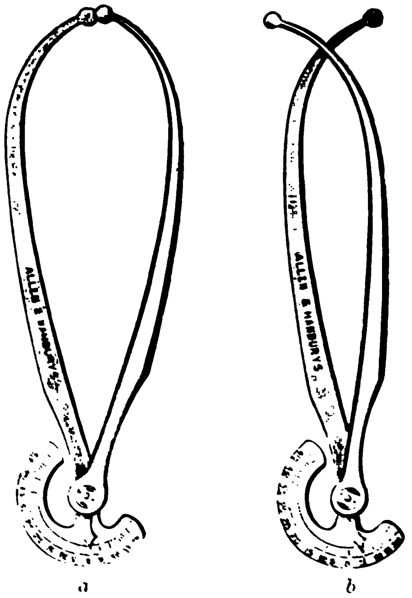


FIG. 176.—PELVIMETER.

The measurements of the pelvis which can be taken in the living subject are *external* and *internal*. They should, whenever possible, be taken with the pelvimeter; some, however, are best measured with the fingers. Methods of estimating the size of the pelvis are called *clinical pelvimetry*.

The most useful form of pelvimeter for external measurements is that of Collin shown in fig. 176. It consists of a pair of callipers, furnished with an index which shows the distance between the points in all positions. The points can be separated from one another by opening the instrument like a pair of forceps, or in the reverse direction by crossing the blades (fig. 176, *b*). The latter position is used for measuring the transverse diameter of the outlet by pressing the crossed points deeply into the perineum, so as to bring them in contact with the inner borders of the ischial tuberosities. The instrument can also be used in this position for internal measurements. In using it for external measurements the instrument should be held by the points—one in each hand, and carefully adjusted to the required diameter, by firm pressure against the bone (fig. 178). The index is then read off.

External Measurements.—(1) *Interspinous Diameter.* This is the distance between the outer borders of the anterior superior iliac spines; its average length is 10 inches (25 cm.).

(2) *Intercristal Diameter.* This is the distance between the outer borders of the iliac crests where these are widest apart; the points of the pelvimeter are moved to and fro until the position of maximum separation has been found, which is usually about 2½ inches behind the anterior superior spines. Its average length is 11 inches (27·5 cm.). From recent observations on the cadaver (Sandstein) it appears that this diameter approximately represents twice the length of the transverse diameter of the brim; and as the latter is very difficult to measure clinically, this relation becomes one of practical importance. In a normally shaped pelvis the intercristal diameter is an inch longer than the interspinous diameter. This proportion is preserved in the generally contracted pelvis, although the length of both may be diminished, but in the flat pelvis there is less than an inch of difference between them, and in well-marked rachitic flattening the interspinous may even be equal in length to the intercristal diameter.

(3) *External Conjugate Diameter.* This is the distance between the tip of the spine of the last lumbar vertebra and the centre of the upper border of the symphysis pubis. This diameter can best be measured in the erect position. The posterior bony point is difficult to find in fat subjects, but in thin women there is no difficulty. Whenever practicable the

lumbar spines should be counted, and a palpable pit or depression will usually be found just below the spine of the fifth vertebra. One point of the pelvimeter is adjusted to this depression, and the other pressed carefully and firmly against the pubes in the position described. The average length of this diameter is 7¾ to 8 inches (19 to 20 cm.). When the spine of the last lumbar vertebra cannot be clearly felt, it may be located as follows: the position of the two posterior superior iliac spines is first marked upon the skin; these points are then united by a horizontal line; a point 1½ to 1¾ inches above the centre of this line will indicate the position of the fifth spine. Shallow depressions can often be recognised over these three bony points, and from them a rhomboidal figure may be constructed upon the lumbo-sacral region known as the *rhomboid* or *lozenge of Michaelis*, the lower sides being formed by the posterior borders of the glutei maximi muscles, the upper sides by lines joining the fifth lumbar spine to the posterior superior iliac spine on each side. The relations of the three bony points to one another can, however, best be recognised by marking out a triangle upon the back as in

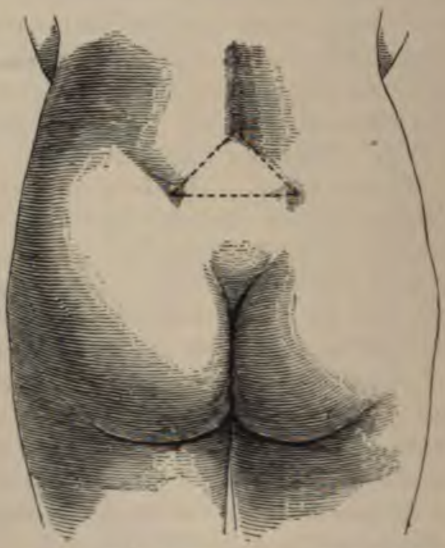


FIG. 177.—THE LUMBO-SACRAL SPINE WITH A NORMAL PELVIS. (MODIFIED FROM BUMM.)

fig. 177; the base line represents the distance between the posterior superior iliac spines (*posterior interspinous diameter*). Its length is variable, and consequently little importance can be attached to it; the average is placed at 4 inches (10 cm.) in a normal pelvis.

In the case of a normal pelvis 3½ to 3¾ inches (9·5 to 10 cm.) must be deducted from the external conjugate diameter to obtain the true conjugate; if the pelvis is flattened, 4 to 4¼ inches (10 to 10·5 cm.) should be deducted in order to allow for the forward displacement of the upper part of the sacrum.

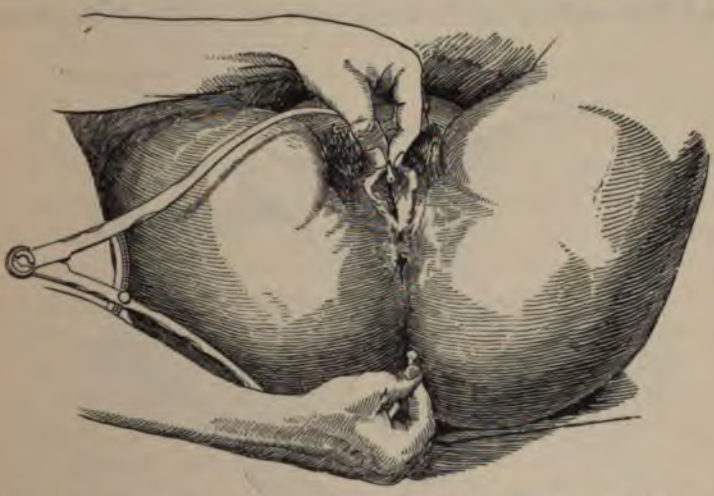


FIG. 178.—MEASURING THE ANTERO-POSTERIOR DIAMETER OF THE OUTLET. (BUMM.)

(4) The *antero-posterior* and *transverse diameters* of the *outlet* (see p. 176) can be directly measured with the pelvimeter, and are of special importance in the case of the generally contracted pelvis, where the size of the outlet is of quite as much importance as that of the brim (fig. 178).

Internal Measurements.—These can be made with the fingers alone, or with an internal pelvimeter. The most important diameter to be estimated by this method is the conjugate of the brim.

(1) *Diagonal Conjugate.*—This is the distance from the centre of the promontory of the sacrum to the centre of the lower

border of the symphysis (fig. 179). It can easily be measured with the fingers only when the pelvic brim is considerably contracted, but it cannot be taken in labour when the presenting part is fixed in the brim. In common with other clinical measurements, it has the disadvantage that its relation to the true conjugate is variable, and difficult to estimate precisely. On an average it may be said to be from ½ to ¾ of an inch longer than the true conjugate—*i.e.* 4¾ to 5 inches. The factors which affect the diagonal conjugate to an extent which it is difficult to estimate are the *thickness* and *depth* of the symphysis, and the *angle* which it forms with the plane of the brim.

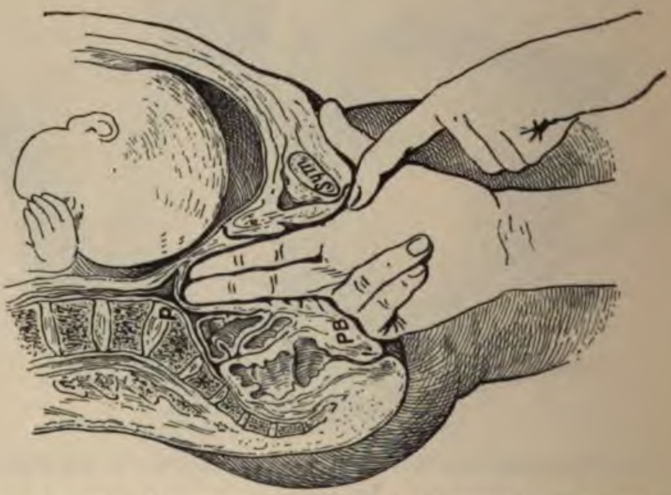


FIG. 179.—MEASURING THE DIAGONAL CONJUGATE. (NORRIS.)

This measurement can best be made with the patient lying on her back, the thighs flexed and supported by assistants, and the buttocks drawn over the edge of the bed; it can also, however, be made in the usual obstetric posture, when no assistance will be required. The index and middle fingers are passed into the vagina and pressed upwards and backwards until the *rounded surface* of the promontory can be felt with the tip of the middle finger. In a pelvis of normal size it is usually impossible to reach the promontory. Care must be taken not to mistake the ridge representing the joint between the first and second sacral vertebræ for the promontory, for the diameter will then appear to be longer than it really is. The point where the lower border of the symphysis comes in contact with the hand is then marked off with the finger-nail, and after withdrawing the fingers the measured distance between this point and the tip of the middle finger represents the length of the diagonal conjugate.

(2) Various methods have been introduced to measure the true conjugate and transverse directly by the use of an internal pelvimeter. The simplest form of internal pelvimeter is that of Skutsch, which may be used for both the conjugate and transverse diameters of the brim. This instrument is a pair of callipers with one rigid and one flexible arm, joined by a screw but not furnished with an index. In measuring the transverse the internal rigid limb is passed into the vagina and first guided up to the centre of the *right* lateral wall of the pelvic brim, while the point of the flexible limb is adjusted to the tip of the *left* great trochanter. The instrument is then withdrawn and the distance between the points measured off. The rigid limb is again passed and the point applied to the centre of the *left* lateral wall of the brim, the external limb being applied to the same point as before. The instrument is then withdrawn and the separation of the points again measured. The difference between the two measurements represents the length of the transverse diameter. In measuring the conjugate the tip of the rigid limb is placed against the centre of the promontory, and the flexible limb adjusted to the centre of the upper border of the symphysis; the second measurement is taken with the rigid limb placed upon the centre of the posterior surface of the symphysis at its upper border. The difference between them represents the true conjugate. In practice this instrument is difficult to work with precision. Experience shows that a rough estimate of the size of the transverse diameter may be obtained by the simple expedient of endeavouring, with two fingers in the vagina, to trace the pelvic brim from the symphysis back to the promontory. If the transverse is of normal length this is very difficult, even under anæsthesia, but if contracted it will be quite practicable. This method can be controlled by halving the intercristal diameter.

(3) Another method of internal pelvimetry must be mentioned—viz. the method of Johnson. This consists in passing the whole hand into the vagina, and endeavouring to fit the

closed fist into the conjugate of the brim. The author of this method elaborated it to such an extent as to define a series of positions of the thumb and fingers, each of which represented a definite length from four to three inches, and he claimed that he was thus able to measure the conjugate precisely. It is clear that, as hands are not of uniform size, there is abundance of room for error, which can only be eliminated by taking careful measurements of the hand in the various attitudes described by Johnson before attempting to apply it. A further objection is that the hand cannot be passed into the vagina except immediately after labour, and the method is therefore not available at the time when measurements are most required.

Clinical pelvimetry clearly yields results which are by no means precise. One measurement must be controlled as far as possible by others, but ultimately the carefully corrected diagonal conjugate is most to be relied upon. For practical purposes a rough estimate of the transverse is also necessary in order to determine the shape of the pelvic brim. Photography by *x*-rays can be employed to show the *shape* of the pelvis with a fair amount of success except in advanced pregnancy. Another useful method of control, however, exists in determining for any given case the relation in size between the pelvis and the fœtal head. This can be done during pregnancy as well as in labour, and is usually employed in deciding upon the mode of treatment required in pelvic contraction. This method will be described in another place (p. 479).

Pregnancy and Labour in Contracted Pelves.—The course of *pregnancy* is not affected to any considerable extent by pelvic contraction. There is no greater risk of abortion, and only a slightly greater risk of premature labour, than when the pelvis is normal; the development of the fœtus is not affected in any way, the full-time child being of average size and weight. Towards the close of pregnancy the uterus may become anteverted, causing a more or less marked condition of 'pendulous belly.' This is mainly due to the unusual height of the presenting part, which cannot enter the narrow pelvis; the level of the fundus is consequently higher than usual, and when spinal curvature is associated with pelvic contraction the forward displacement of the uterus becomes very marked. Multiparity with lax abdominal walls, and diminutive stature, still further exaggerate the anteversion. Pelvic contraction has been already alluded to as a cause of incarceration of the retroverted gravid uterus at the fourth month (p. 95).

The general course of *labour* is modified by pelvic contraction in various ways:

(1) Abnormal presentations are three or four times commoner in contracted than in normal pelves; the reasons for this have already been mentioned.

(2) Prolapse of the cord is much commoner than in normal pelves.

(3) When natural delivery occurs, labour is prolonged and the mechanism is modified.

(4) Unless the true conjugate is at least three and a-quarter inches, even with artificial aid the survival of the child is very unlikely.

(5) The maternal risks are increased by the greater length and difficulty of the labour, and by the frequent necessity of employing artificial methods of delivery.

(6) The fœtal risks are increased in natural delivery by severe compression of the head during its passage through the narrow pelvis, and under other circumstances by the operations required to effect delivery, some of which involve the destruction of the fœtus.

The *clinical phenomena* are modified in several important particulars. When the degree of obstruction is considerable, violent uterine action may be aroused, which may either pass into *tonic contraction*, or give place to *secondary inertia*. The cervix dilates slowly and the first stage is therefore prolonged; the bag of waters is voluminous and frequently ruptures prematurely; œdema of the anterior lip of the cervix may occur from the compression of the lower uterine segment between the head and the pubes. A large caput succedaneum forms in vertex or face presentations; it may be so large as to present at the vulva before the head has passed the brim. In a rachitic flat pelvis the second stage is often unusually rapid, when the patient is a multipara; in the generally contracted pelvis it is always long and difficult.

The shape of the pelvis and the length of the conjugate are the factors which chiefly influence the course of labour. With the three common varieties of contracted pelvis spontaneous delivery occurs in from 40 to 63·3 per cent. of all cases; the simple flat pelvis is the most favourable in this respect, then the generally contracted pelvis, and lastly the rachitic flat pelvis. The frequency of spontaneous delivery diminishes rapidly in proportion to the diminution of the conjugate. Thus the Vienna statistics previously referred to show the following percentages:

C. V.	9½ cm.	=	(3·8 in.)	spontaneous	75·6 %
C. V.	9 "	=	(3·6 ")	"	58·7 %
C. V.	8½ "	=	(3·4 ")	"	49·7 %
C. V.	8 "	=	(3·2 ")	"	25·0 %

Mechanism.—I. *Flat Pelvis.*—(*a*) In *head presentation* the mechanism is usually modified in the following manner, although many variations may be met with: The head enters the brim more or less extended, and in the transverse instead of the oblique diameter. Nägele's obliquity (anterior asynclitism) is usually well marked in the second stage of labour. When the contraction of the conjugate is considerable, lateral displacement of the head towards the side occupied by the occiput occurs early in labour; this is rendered possible by the increased length of the transverse diameter, and tends to promote flexion, because the sinciput is delayed in the narrow conjugate, while the occiput, having more room,

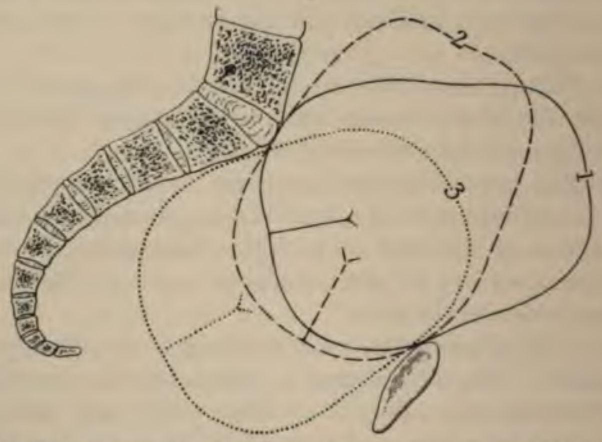


Fig. 180.—Labour in Flat Pelvis: Rotation of the Head in Passing the Brim. (Clarence Webster.)

1. Well-marked Nägele's obliquity. 2. Forward rotation. 3. Backward rotation.

is free to descend. The result of this movement is that the bi-parietal diameter is brought into the wide lateral part of the brim, while the bi-temporal diameter engages in the conjugate. With anterior asynclitism the head passes through the brim by a movement of rotation round the *promontory* (fig. 180). As it descends, the sagittal suture approaches the pubes, bringing the posterior parietal bone first into the cavity (fig. 180, 2). Rotation in the opposite direction next occurs, the sagittal suture approaching the sacrum (fig. 180, 3) and thus bringing the anterior parietal bone into the cavity. With posterior asynclitism at the commencement of labour, a similar movement of rotation round the *pubes* occurs. The mechanical advantage of this movement of rotation is indicated in fig. 181. The lateral inclination of the head which accompanies this movement tilts the bi-parietal plane *c—d*, and brings into the brim a plane the diameter of which is indicated by *b—a*. This is the super-sub-parietal diameter, measuring about a quarter of an inch less than the bi-parietal. The widest part of the head thus escapes direct engagement in the plane of the brim. Forward rotation of the occiput will occur if the head is flexed when it reaches the pelvic floor. When the head has passed the brim, there will be no further difficulty in delivery unless the shoulders are disproportionately large.

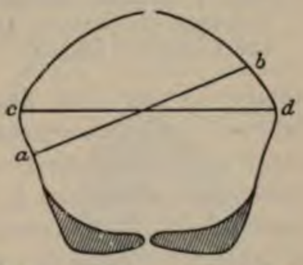


FIG. 181.—WEDGE SHAPE OF FŒTAL SKULL ON CORONAL SECTION. (DAKIN.)

c—d. Bi-parietal diameter.
b—a. Super-sub-parietal diameter.

If the movement of lateral displacement does not occur, as labour proceeds, the head may become completely extended, the posterior part being prevented from descending while the anterior part has sufficient space for this movement. This may result in a brow or face presentation.

The moulding of the fœtal head is modified; there is well-marked lateral asymmetry, the middle of the posterior parietal bone being much depressed; but in the longitudinal plane overriding of the bones is not excessive (fig. 182). Often a depression or a depressed fracture of the posterior parietal bone is caused by the pressure exercised upon it by the promontory (figs. 235 and 236). Or, after birth, a depression is found upon the posterior parietal bone, which marks the line of compression by the promontory in the movements of lateral displacement and rotation round the sacrum.

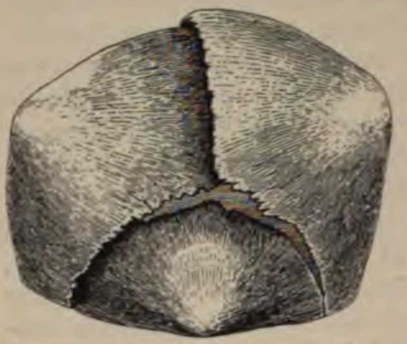


FIG. 182.—POSTERIOR ASPECT OF FŒTAL SKULL: EXTREME MOULDING FROM LABOUR IN FLAT PELVIS. (RIBEMONT-DESSAIGNES AND LEPAGE.)

(*b*) In *breech presentation* the mechanism of delivery of the after-coming head is modified as follows: The head engages with its occipito-frontal diameter in the long transverse diameter of the brim; a movement of lateral displacement, similar to that just described, should next occur, and be followed by a movement of flexion. Owing to the wedge shape of the fœtal skull on coronal section (fig. 181), a certain mechanical advantage is obtained by the after-coming head, inasmuch as the narrow end of the wedge—*i.e.* the base of the skull—first enters the brim. The bi-parietal diameter will therefore tend to be reduced somewhat by compression during its passage, and the difficulty will thus be diminished. Rotation round the promontory, bringing first the posterior, and then the anterior, parietal bone into the pelvic cavity, will occur when the degree of contraction is considerable.

II. *Generally contracted Pelvis.*—In this form of contracted pelvis the mechanism of labour is not greatly modified, as the proportions of the pelvis are normal. In *head presentation* the movement of *flexion* is exaggerated, reducing the diameter of engagement to the utmost extent. *Internal rotation* is controlled by the *inclined planes of the ischium*, not by the pelvic floor. Upon the inner surface of the ischium a shallow ridge may be traced running from the ilio-pectineal eminence to the ischial spine; behind this line is a smooth bony surface, the *posterior ischial plane*; in front of it is a similar surface, the *anterior ischial plane* (fig. 89 *a*). When the head lies in the oblique diameter (first position) the occiput will come in contact with the left anterior plane, the sinciput with the posterior plane of the opposite side. The inclination of these planes is such that a body in contact with the anterior plane is directed forwards and inwards (towards the middle line), in contact with the posterior backwards and inwards. Their combined effect will therefore be to carry the head from the oblique into the antero-posterior diameter. Forward rotation will occur in the first and second positions, backward rotation in the third and fourth. Unless the head tightly fits the pelvis this effect will not be produced; therefore it is only in the case of a generally contracted pelvis, or a normal pelvis with an abnormally large head, that it can be looked for. It follows that backward rotation is the rule in occipito-posterior positions with a generally contracted pelvis and a head of average size. The passage of the head through the outlet is rendered unusually difficult by the diminution of the antero-posterior and transverse diameters of the lower pelvic strait. In this respect great difference exists between the flat and the generally contracted pelvis.

In *breech presentation* also the mechanism of labour is not appreciably modified, but, owing to the reduction in length of the diameters of the outlet, displacement of the arms is very frequent and the delivery of the after-coming head is unusually difficult; for this reason breech presentation is very unfavourable to the fœtus in a generally contracted pelvis. If extension of the head should occur perforation will be unavoidable.

The moulding of the head is of the normal type, but is extreme in degree (fig. 183); depression and fracture of the bones are, however, uncommon.

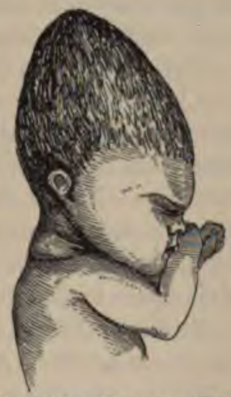


FIG. 183.—EXTREME HEAD MOULDING FROM LABOUR IN GENERALLY CONTRACTED PELVIS. (BARBOUR.)

Labour is more difficult in a generally contracted pelvis than in a flat pelvis with an equal length of conjugate, for the reason that the former is contracted throughout, the latter only at the brim. In the flat pelvis all difficulty ceases when the head has passed the brim; in the generally contracted pelvis the delivery of the head through the narrow outlet is the most difficult stage.

Management of Labour in Contracted Pelves.—(*a*) When the degree of pelvic contraction is so great as to prevent the birth *per vias naturales* of a viable child under any circumstances, the case should be treated by Cæsarean section at term, unless this is absolutely declined by the patient, when abortion must be induced. (*b*) When the pelvis is large enough to admit the passage of a viable child, but not large enough for a full-term child, premature labour should be induced at the time appropriate to the case, if the opportunity of doing so offers itself. If the time for induction of premature labour has passed by, the case should be allowed to go to term, and an attempt then made to procure a living child *per vias naturales* with the aid of symphysiotomy, version, or forceps; or, if there is insufficient pelvic space for these operations, Cæsarean section should be performed. In the application of these principles to the different degrees of pelvic contraction some difference of opinion exists.

Extreme Pelvic Contraction (Conjugate under 2¾ inches: 7 cm.).—The birth of a viable child *per vias naturales* is here impossible. Abortion may be induced before the sixth month; if, however, the case first comes under observation later than this or during labour, when the child is alive, Cæsarean section should be performed; when dead, it should preferably be delivered by craniotomy if there is sufficient pelvic space for this operation (p. 526).

Moderate Pelvic Contraction (Conjugate 2¾ to 3¼ inches: 7 to 8 cm.).—It is with regard to cases in this group that practice is unsettled. When the opportunity offers, premature labour may be induced at the appropriate time. Experience shows, however, that the success of this operation depends greatly upon the degree of pelvic contraction, the chances of survival of the child being much greater with the larger pelves than the smaller ones. In one hundred cases Bar found the fœtal mortality of induction as follows:

Conjugate	Fœtal Mortality
6–7 cm. (2⅖–2⅘ in.)	80 %
7–8 „ (2⅘–3⅕ „)	53 %
8–9 „ (3⅕–3⅗ „)	12 %
9–10 „ (3⅗–4 „)	8·6 %

Owing to the safety of uncomplicated Cæsarean section at the present time, it should be preferred to induction of premature labour in pelves of or under three and a-quarter inches. When the case does not come under observation until a late stage of labour, and the circumstances are unfavourable for the performance of Cæsarean section without undue risk (see p. 518), symphysiotomy should be performed if the child is alive, craniotomy if it is dead.

Slight Pelvic Contraction (Conjugate over 3¼ inches: 8 cm.).—In this group induction of premature labour has been very extensively employed and yields very satisfactory results from the point of view of the mother, but is not so satisfactory as regards the child, the fœtal mortality being about 10 per cent. The calculation of the appropriate time for induction must be carefully made in the manner indicated on page 477. When, however, the case is seen for the first time during labour, careful management may still ensure a favourable termination both to mother and child. Assistance should not be withheld when the second stage is reached, because of the serious risks of continued pressure upon the fœtal head.

Practical experience shows that on the whole forceps is more useful that version in all kinds of pelvic contraction. Thus the Vienna statistics already quoted show that of eighty-three cases of flat pelvis (3¼ to 4 inches: 8 to 10 cm.) delivered by forceps the fœtal mortality was 31 per cent.; while in about the same number of cases of version the mortality was 53 per cent. It would therefore appear that there is a better chance of saving the child by forceps than by version in flat pelvis. When the pelvis is generally contracted, head presentation is decidedly more favourable than breech; version should therefore be avoided, and the second stage terminated by the application of forceps.

Rare Forms of Contracted Pelvis

A. Due to disease affecting the skeleton generally.

(1) *Osteomalacic pelvis.*
(2) *Pseudo-osteomalacic pelvis.*

B. Due to disease of the pelvic joints.
  (3) *Nägele's* or *Oblique pelvis.*
  (4) *Robert's* or *Transversely contracted pelvis.*
  (5) *Oblique pelvis* due to disease of the hip-joint.

C. Due to disease of the vertebral column.
  (6) *Kyphotic pelvis.*
  (7) *Scoliotic pelvis.*
  (8) *Spondylolisthetic pelvis.*

D. Due to tumours of the pelvic bones.

(1) *Osteomalacic Pelvis* (Malacostean Pelvis, Triradiate Pelvis).—Osteomalacia, or mollities ossium, produces a characteristic pelvic deformity shown in figs. 184 and 185. The softening produced by this disease weakens the pelvic bones so much that they yield in all directions to pressure, with the result that the pelvis collapses and entirely loses its shape. The lateral pelvic walls fall in, this change becoming first apparent in relation to the anterior part of the brim in front of the acetabula (fig. 184). This produces the characteristic 'beaking' of the pubes. As the deformity progresses the pelvic walls may come almost in contact with one

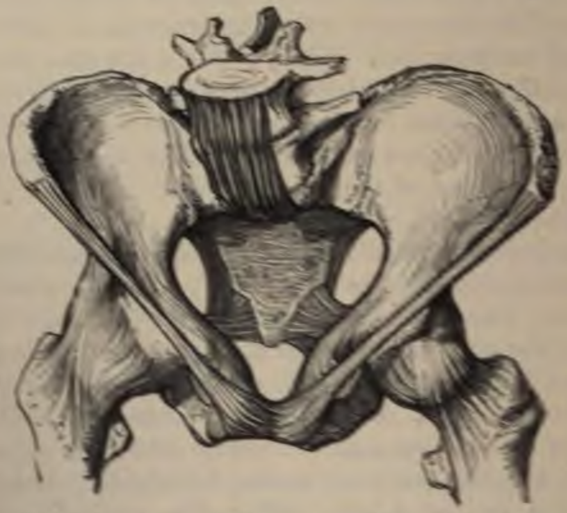


FIG. 184.—OSTEOMALACIC PELVIS WITH MODERATE DEFORMITY.

another in their anterior parts. The sacrum becomes displaced forward, the spine is curved, the beaking of the pubic bones increases, the iliac crests become twisted, and extreme deformity results, the pelvic brim being reduced to a triradiate slit (figs. 185 and 193). In addition to the changes in the pelvis, marked deformity of the long bones and of the vertebral column occurs. Extreme degrees of pelvic contraction are caused by this disease.

It has been found that removal of the ovaries sometimes arrests the morbid process in the bones, and in consequence Cæsarean section, followed by removal of the uterus and ovaries, has been advocated as the best treatment during pregnancy. Cure of existing deformity is of course impossible, but in a certain proportion of cases the advance of the disease has been arrested by this operation. Abortion may be induced in the early months as an alternative to the radical and curative operation.

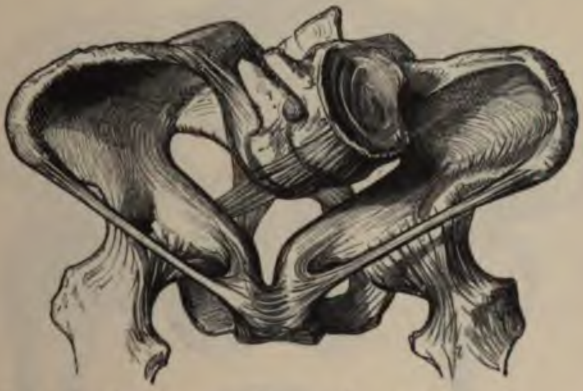


FIG. 185.—OSTEOMALACIC PELVIS: ADVANCED DEFORMITY.

(2) *Pseudo-osteomalacic Pelvis*.—This variety is due to rickets, and has received its name from the resemblance it presents to osteomalacic contraction (fig. 186). The pubic bones are slightly beaked, but the lateral pelvic walls have not yielded to the same extent as in the former variety. The anterior portions of the iliac crests are not normally incurved, so that the interspinous equals or exceeds the intercristal diameter in length. Severe rickets is the cause of the deformity, and general rachitic changes in the skeleton

are always associated with it. Treatment in pregnancy is governed entirely by the degree of contraction present. The recognition of this and the foregoing variety is facilitated by the obtrusive signs of general bone disease which accompany them.

(3) *Nägele's Pelvis.*—This variety is caused by disease occurring in infancy, in or near *one* of the sacro-iliac synchondroses; as a result ankylosis with bony union of the joint occurs, and the development of the ala of the sacrum on the affected side is more or less completely arrested. The resulting deformity is shown in fig. 187. On the affected side the ilio-pectineal line is almost straight, and the great sacro-sciatic notch is much narrower than its fellow. The symphysis pubis is displaced for half an inch or more to the sound side of the mesial plane of the body. The oblique diameter of the sound side (the right in fig. 187) is considerably diminished in the whole pelvis from brim to outlet; the opposite oblique, the transverse and antero-posterior diameters,

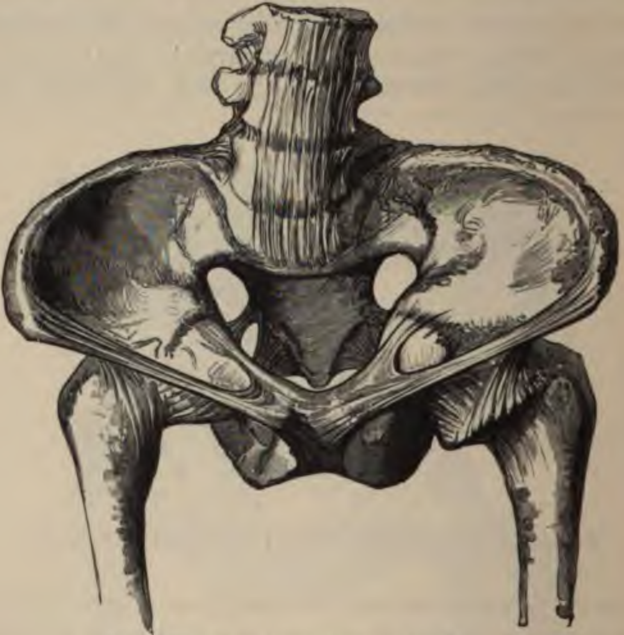


FIG. 186.—PSEUDO-OSTEOMALACIC PELVIS.

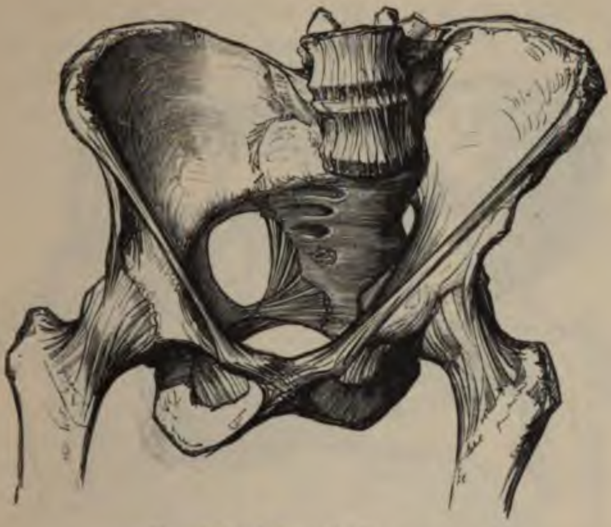


FIG. 187.—NÄGELE'S PELVIS.

are little affected; from narrowing of the sacro-sciatic notch, the sacro-cotyloid diameter (promontory to back of acetabulum) of the affected side is very considerably less than its fellow. The distance between the posterior superior iliac spines is reduced, and the pubic arch is asymmetrical.

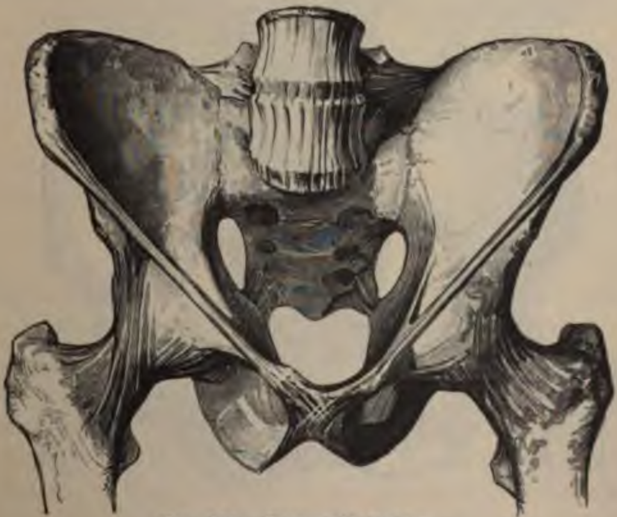


FIG. 188.—ROBERT'S PELVIS.

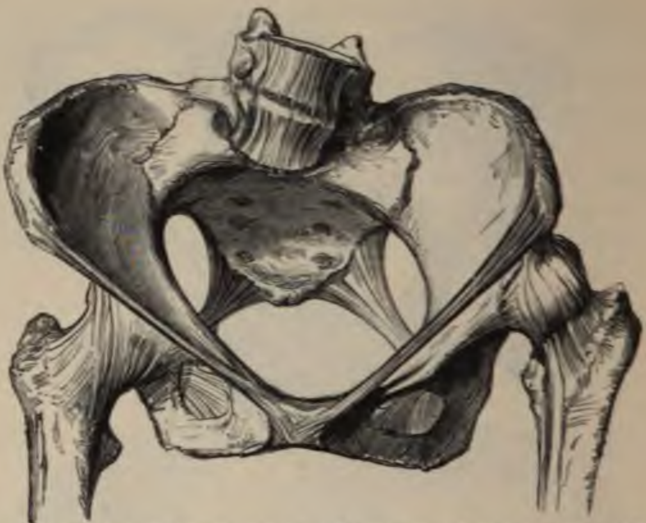


FIG. 189.—OBLIQUE PELVIS DUE TO CONGENITAL DISLOCATION OF LEFT FEMUR.

The diagnosis of this form of contracted pelvis is difficult. The patient is usually well developed, and shows no sign of lameness, or of general bone disease. The oblique and sacro-cotyloid diameters are very difficult to measure clinically, and, as we have seen, the diameters which can be estimated

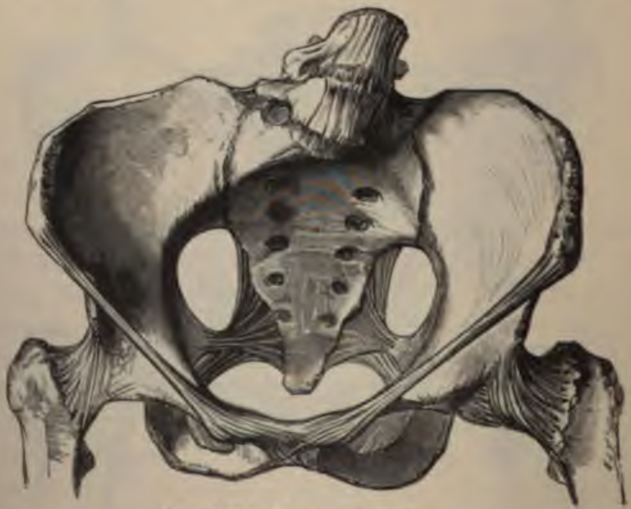


FIG. 190.—KYPHOTIC PELVIS.

are not greatly affected. The flattening of the lateral pelvic wall on the affected side can be recognised by careful digital examination under anæsthesia, and the lateral displacement of the symphysis pubis is a valuable indication of the condition. An x-ray photograph of the pelvis is the best method of diagnosis. Labour will be difficult, as the diminution in the area of the pelvic brim and cavity is considerable.

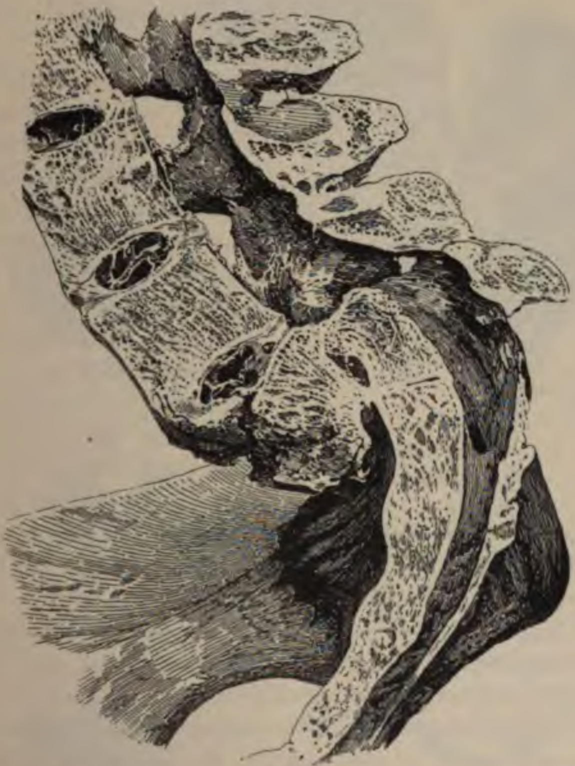


FIG. 191.—THE SACRUM AND LUMBAR VERTEBRÆ FROM A CASE OF SPONDYLOLISTHESIS. (NEUGEBAUER.)

(4) *Robert's Pelvis.*—This form of pelvis is due to *bilateral* synostosis of the sacro-iliac synchondroses, occurring in infancy; the lesion is the same as in Nägele's pelvis, but it affects both joints (fig. 188). The ala of the sacrum is imperfectly developed upon both sides; both ilio-pectilineal lines are nearly straight; both sacro-sciatic notches are diminished in width.

The result is a marked diminution in the transverse diameter of brim, cavity, and outlet of the pelvis; the pubic arch also is narrowed. The distance between the posterior superior iliac spines is considerably reduced. Diagnosis is easier than in Nägele's pelvis, as the transverse diameters of the brim and the outlet can be more readily estimated than the oblique.

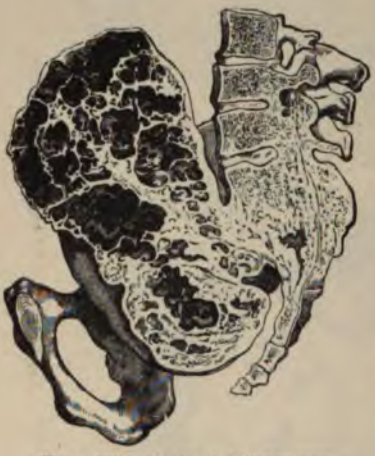


FIG. 192.—SACRAL EXOSTOSIS. (GALABIN.)

(5) *Oblique Pelvis due to disease of the hip-joint.*—Various forms of oblique deformity may be produced by subluxation of the hip (which may be uni- or bi-lateral, congenital or infantile) and by caries of the joint. Spinal curvature is almost always associated with these lesions. The resulting lameness and deformity will direct attention to the condition of the pelvis. In fig. 189 it will be seen that there is well-marked tilting of the pelvis, and the flattening of the lateral pelvic wall affects the sound side, reducing the length of the left oblique diameter.

(6) *Kyphotic Pelvis.*—This variety of contracted pelvis is due to angular curvature of the lumbar spine, the result of caries followed by absorption of bone and fusion of the bodies of adjacent vertebræ (fig. 190). Compensatory lordosis of the dorsal spine usually accompanies the condition. The chief changes in the pelvis are found at the outlet, where the transverse and antero-posterior diameters are greatly diminished. The conjugate diameter of the brim is elongated by backward rotation of the sacrum, and the whole pelvis becomes funnel-shaped. Diagnosis is assisted by the condition of the spine; also the diameters of the outlet are capable of clinical measurement. Delivery through the narrow outlet will be possible with forceps except in well-marked contraction, when craniotomy will be required.

(7) *Scoliotic Pelvis.*—Lateral curvature of the spine may produce a certain amount of asymmetry of the pelvis, one

side being somewhat more roomy than the other. Only slight degrees of pelvic contraction can, however, be produced

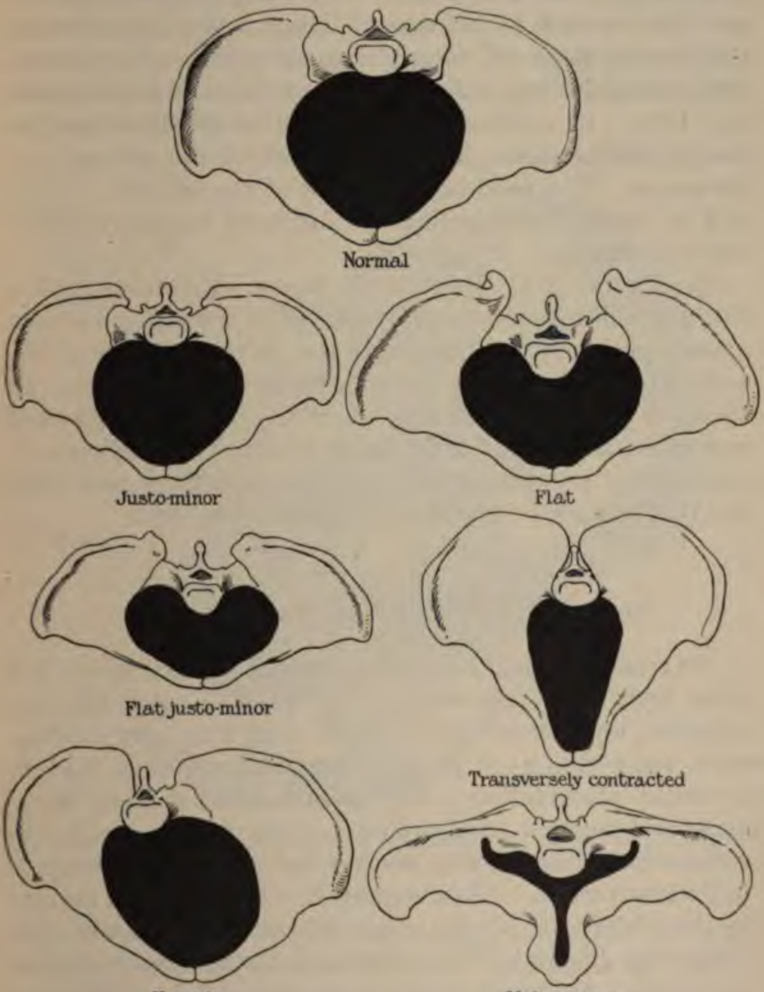


FIG. 193.—THE OUTLINE OF THE PELVIC BRIM IN THE PRINCIPAL VARIETIES OF CONTRACTED PELVIS. (BUMM.)

in this way. When associated with rickets, scoliosis may produce an extreme degree of oblique deformity associated with flattening (fig. 175).

(8) *Spondylolisthetic Pelvis.*—This extremely rare form of pelvic contraction is due to forward dislocation from caries of the body of the fifth lumbar vertebra (spondylolisthesis—*σπόνδυλος*, vertebra; *ὀλίσθησις*, gliding). The lumbar vertebræ become displaced, descend into the pelvis, and of course greatly diminish the available length of the conjugate diameter (fig. 191). In addition the pelvic outlet is diminished by forward displacement of the lower part of the sacrum and the coccyx. The resulting deformity of the spine is obvious, and on vaginal examination the displaced lumbar vertebræ can be recognised.

(9) *Tumours of the Pelvic Bones.*—Exostoses, either single or multiple, are sometimes found in the pelvis, the commonest positions for them being the anterior surface of the sacrum (fig. 192) and the posterior surface of the pubes. In the latter position a small exostosis which has been overlooked may cause unexpected difficulty in labour. Cartilaginous or sarcomatous growths of large size are sometimes met with, and may cause insuperable obstruction to delivery.

Abnormal Conditions of the Soft Parts

Ovarian Tumours.—When situated entirely *above the pelvic brim,* these tumours do not give rise to much difficulty in labour, even though of very large size. They may occasion some exaggeration of uterine obliquity, and thus lead to abnormal presentations; but in this situation they never cause obstruction. Axial rotation of the tumour, leading to serious consequences, may occur either during pregnancy or in the puerperium. The diagnosis of a large ovarian tumour in the *abdomen* as a rule is not difficult during labour; the differential diagnosis of hydramnios has been already referred to (p. 114). Operative treatment is rarely called for in labour, and should be postponed until the patient is convalescent, unless acute symptoms arise during the puerperium.

When situated *wholly* or *partially* in the *pelvic cavity,* ovarian tumours cause serious obstruction in labour; they then lie below the presenting part and prevent the descent of the fœtus, and its passage through the outlet (figs. 32 and 194). [illegible]aneous delivery, although very rare, may occur in the following ways: (1) the tumour, if cystic, may be ruptured by compression, and the collapsed cyst may be too small to prevent the passage of the fœtus; (2) the tumour may rupture the pelvic floor and be expelled in front of the presenting part, either through the anus or the vulva. If the obstruction proves insuperable and is not artificially relieved, rupture of the uterus will occur.

The diagnosis of the presence of a *pelvic tumour* is easy during labour; but fibroid and ovarian tumours are often mistaken for one another, for under continuous pressure a cystic tumour becomes tense and its walls œdematous, so that its consistence appears to be that of a soft solid mass, while fibroid tumours lose their naturally hard consistence during pregnancy. Unless the head is fixed in the pelvic brim it is generally possible, under anæsthesia, to push the tumour past the presenting part above the pelvic brim, where it will be out of the way and cause no further trouble; but if reposition is impossible from adhesions, or from any other cause, the best

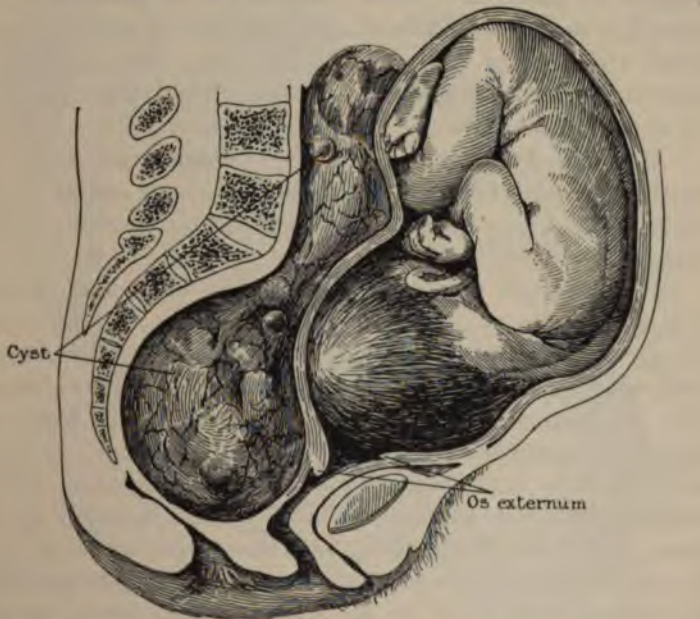


FIG. 194.—OVARIAN CYST OBSTRUCTING LABOUR; PARTIAL DILATATION OF THE CERVIX HAS OCCURRED. FROM A FROZEN SECTION. (BUMM.)

treatment is immediate *ovariotomy*. The alternative method of delivery by forceps or craniotomy, after tapping the tumour, has been abandoned; the life of the child was necessarily almost always sacrificed, and it was found that so much injury was caused to the tumour in dragging the body of the fœtus past it that peritonitis from bruising and rupture frequently ensued in the puerperium, occasioning a high maternal mortality. Ovariotomy may be performed by the vaginal or abdominal route; the latter is preferable, and should, if possible, be immediately followed by delivery of the child with forceps. If performed in time, the prognosis is good both to mother and child, although ovariotomy in labour is, of course, more serious than in pregnancy.

Uterine Tumours.—The two commonest forms of uterine tumour—fibromyoma in the body, and cancer in the cervix—are not infrequently encountered in connection with pregnancy.

The influence exerted by *uterine fibroids* upon labour is governed almost entirely by their position. Those which occupy the lower uterine segment, or any part of the cervix, even when of comparatively small size, cause serious obstruction to delivery; this results partly from their bulk, but mainly from the fact that they prevent the normal dilatation of these parts during labour. It is not easy, before labour commences, to tell whether a fibroid tumour situated in the lower part of the uterine body will cause obstruction or not, for such tumours, when they do not encroach upon the lower uterine segment, may, by the action of the uterus, become drawn up out of the pelvis as labour proceeds, so as not to hinder the birth of the child. Fibroids of the uterine body which are *interstitial* give rise to mal-presentation and irregular uterine action, and sometimes cause post-partum hæmorrhage by interference with muscular retraction. *Sub-peritoneal* fibroids, as a rule, exert no effect whatever upon labour; but when growing from the lower part of the posterior uterine wall they may become incarcerated in the pouch of Douglas, and give rise to the most serious obstruction (fig. 195). Fibroids in any position are liable to become infected in the puerperium if the sterility of the uterine cavity is not maintained. A uterus which contains a fibroid tumour is, however, not more likely to become infected during or after labour than one which does not. Fibroids are also liable to undergo certain degenerative changes, apart from infection, during the puerperium. Fibroid polypi have no influence upon labour, but may become detached and expelled during labour or in the puerperium.

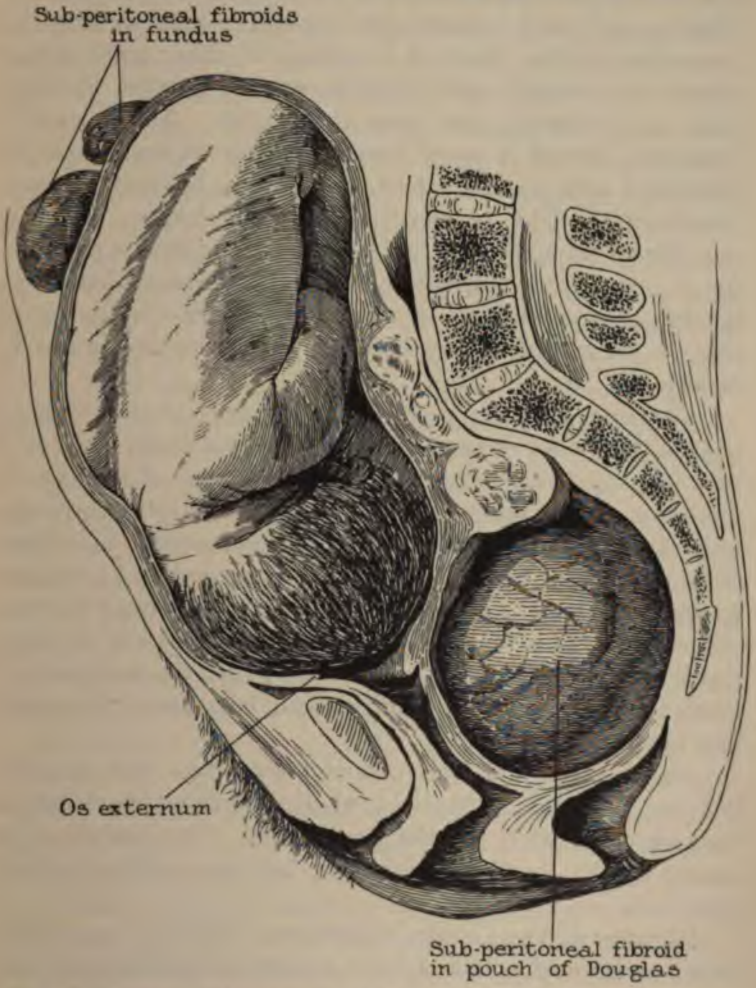

Sub-peritoneal fibroids in fundus
Os externum
Sub-peritoneal fibroid in pouch of Douglas

FIG. 195.—LABOUR OBSTRUCTED BY A FIBROID TUMOUR; CERVIX PARTLY DILATED. FROM A FROZEN SECTION. (BUMM.)

Treatment turns entirely upon the question of obstruction. If it is clear that there will be insuperable obstruction, the best treatment is to allow pregnancy to continue and perform Cæsarean hysterectomy at or near term (p. 530). It can seldom be said, however, before labour that insuperable obstruction will result, except in the case of interstitial cervical fibroids and sub-peritoneal fibroids which have become incarcerated in the pouch of Douglas. In other cases labour should be awaited, and suitable means adopted to overcome any difficulty that may then arise. The Cæsarean operation, should it prove necessary, may in such cases be performed with perfect safety if there has been no previous interference. The induction of abortion for an obstructing fibroid tumour is a difficult and dangerous operation, for it may prove impossible to secure adequate dilatation, making the evacuation of the uterine cavity a matter of extreme difficulty. In consequence this procedure is not to be advised.

Cancer of the Cervix.—*Advanced cancer* of the cervix is one of the most serious complications of labour which can be met with. Owing to the loss of the normal resilience of the tissues, dilatation is impossible, and spontaneous delivery can only occur after extensive laceration. The puerperium may then terminate fatally from sloughing of the bruised and lacerated tissues. Treatment consists in delivery by Cæsarean section, followed by supra-vaginal amputation of the uterus through healthy tissue: when the child is dead it may be delivered by craniotomy if sufficient dilatation can be secured to render this practicable.

Early cancer of the cervix often does not prevent delivery *per vias naturales*: vaginal hysterectomy should be performed early in the puerperium. The treatment of cancer of the cervix in pregnancy has been referred to on page 146.

Rigidity of the Cervix.—The term 'rigidity,' as applied to the cervix during labour, has a strictly conventional significance, and may be understood to include all the conditions in which dilatation is retarded. In one class of cases the cervical tissues are to all appearances healthy, although dilatation is slow or incomplete; this condition is called *functional rigidity* of the cervix. In another class some morbid condition of the [redacted] present, to which the fault may be attributed; this *organic rigidity.*

(1) *Functional rigidity* is met with in primiparæ much more frequently than in multiparæ. It may arise from irregular or weak uterine contractions in the first stage of labour (*primary inertia*); from premature rupture of the membranes resulting in loss of the natural cervical dilator—the bag of waters; from morbid adhesion of the membranes in the lower uterine segment, preventing the formation of the bag of waters; from an unusual density of the cervical tissues, met with, as is believed, in elderly primiparæ (over thirty years); from œdema of the cervical tissues induced by compression when the pelvis is contracted, or when in a normal pelvis the vertex is extended; and possibly, in the last place, from spasmodic contraction of muscular fibres in the cervix. It will be seen that some of these conditions are in reality abnormalities in the mechanism of dilatation. Functional rigidity of the cervix often causes great prolongation of the *first stage* of labour, which in turn entails exhaustion of the patient; as long as the membranes remain unruptured there is little risk to the fœtus. Clinically speaking, cases may be divided into two groups: those in which the pains are weak, and those in which the pains are strong. In the former primary uterine inertia (see p. 320) is present, and is an important factor in causing the difficulty in dilatation; in the latter the uterine action is normal.

Treatment depends in the main upon the cause. If the action of the uterus is at fault, abdominal massage, a hot bath, or hot vaginal douches may be employed to stimulate the contractions. On the other hand, if the pains are strong, repeated inhalations of chloroform sufficient to produce only slight anæsthesia, and the administration of chloral or bromide in repeated small doses, are the most useful remedies. In the spasmodic variety, it is said that local application to the cervix of a 10 per cent. solution of cocaine is useful, but the recognition of this variety is difficult. If these means are unsuccessful, dilatation must be assisted, and as this involves very little risk to the mother it should not be postponed until she is tired out. If the external os is about one-half dilated and the head presents, the patient should be anæsthetised, dilatation completed by the fingers, and forceps at once applied. In a breech presentation a leg should be pulled down. If, however, the cervix is less than half dilated, a Champetier bag should be introduced; this will dilate the cervix in an hour or two and delivery can then be effected.

(2) *Organic rigidity* of the cervix may be due to adhesion of the lips of the os externum to one another, to small size of the os externum (*pin-hole os*), to hypertrophic elongation of the cervix, to cicatrices, or to the presence of a small cystic or solid cervical tumour. Fibroid and malignant cervical tumours, already considered, may also be regarded as causes of organic rigidity. *Small size of the os externum* in a primipara sometimes leads to a curious form of partial dilatation of the cervix, in which the whole of the cervical canal becomes fully opened up except the os externum itself. The head descends low into the vagina, the wall of the cervix is tightly stretched over it, and may be mistaken for the unruptured bag of waters if the small aperture representing the os, and situated upon the lowest part of the bulging swelling, should be overlooked. *Small tumours* should be dealt with, if possible, by *removal*; the other conditions may be treated either by *incision* or by some method of *artificial dilatation*. Incision is probably the best treatment for all but hypertrophic elongation, which must be dealt with by artificial dilatation. In performing this small operation an anæsthetic will not be required unless the patient is unusually nervous; a Sims speculum should be passed to expose the cervix, and with scalpel or scissors a series of shallow radiating notches made in the margin of the os externum. If cicatrices are present, the incisions should be made through the cicatricial tissue, and dilatation should then be allowed to proceed naturally. The same methods of artificial dilatation may be employed as in the case of functional rigidity.

Rigidity of the Pelvic Floor.—In elderly primiparæ (over thirty) the perineal body and the other tissues composing the pelvic floor appear to be deficient in elasticity, and consequently dilatation of the vulva at the end of the second stage does not proceed normally. The head may therefore be delayed for a long time upon the pelvic floor, slightly distending the vulva with each pain, but unable to escape; unless the uterine contractions are unusually powerful, forceps will be required to extract it. On the other hand, if the uterine action is violent, the head will be driven by great force through the undilated vulva, causing a serious perineal laceration. Occasionally in such cases the vulva does not dilate at all, and a laceration then occurs in the perineal body between the fourchette and the anus, through which the head and body of the child escape. This is termed *central* or *intra-perineal* rupture. It is not always mesial in position, and the latter term is therefore preferable. Attention must be paid in all such cases to the proper management of expulsion, and time allowed for the perineum to stretch. If a tear appears to be inevitable, two lateral incisions may be made in the anterior edge of the perineum (episiotomy); when tearing occurs it will then follow the lines of these incisions and be directed backwards and outwards away from the rectum, thus avoiding the risk of lacerating the sphincter ani (fig. 196).

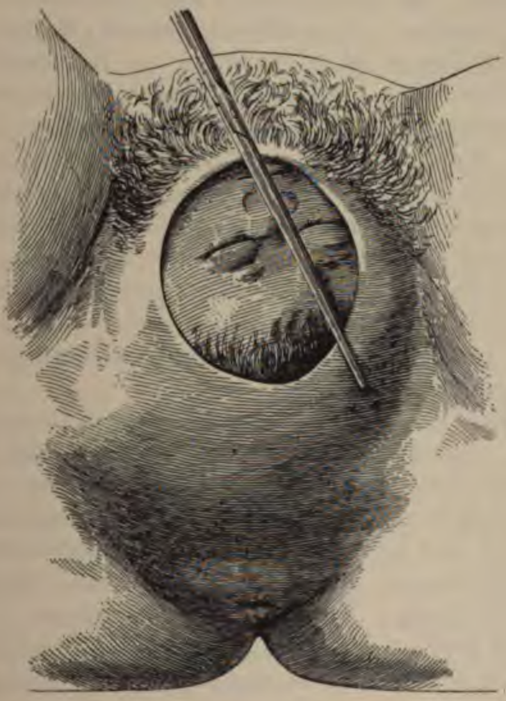


Fig. 196.—Episiotomy in a Face Presentation. (Edgar.)

Abnormalities in the Action of the Uterus

Precipitate Labour.—Cases are occasionally met with in which labour proceeds so rapidly as to disturb the normal mechanism, the stages of dilatation and expulsion occurring simultaneously, or being indistinguishable from one another. After only two or three violent pains have been felt the child may suddenly be expelled, and be followed immediately by the after-birth; the whole process thus apparently occupying only a few minutes. It is difficult, however, in such cases to eliminate an element of uncertainty—viz. the possibility that uterine contractions—painless but effective—have been in progress unobserved by the patient, and have effected the usual dilatation; the violent pains which suddenly ensue thus representing only a precipitate second stage. The conditions which lead to precipitate labour are excessive force of the uterine contractions, and diminished resistances in the pelvis. Nothing is known of the causes of the former; but as instances of the latter may be mentioned the justo-major pelvis, and the relaxed or lacerated conditions of the cervix and pelvic floor, often met with in multiparæ.

Precipitate labour is unfavourable both to the mother and the child. Rapid exhaustion of the uterus leading to post-partum hæmorrhage may occur, or the process of uterine inversion may be set up (see p. 345); also serious lacerations of the cervix and perineum may occur in primiparæ, and in consequence there is increased risk of sepsis. Owing to the fact that the patient is taken unawares, delivery may occur in the erect position and the child may be killed by a fall on the floor, if the cord gives way under the strain. Many instances have occurred where it has been expelled into the water-closet. Of 800 cases of precipitate labour collated by Bayer, it was found that in only 15·5 per cent. was the patient delivered while lying down. The opportunity of treating such cases will seldom arise; uterine action should be retarded as much as possible by the free administration of chloroform.

Uterine Inertia.—Two varieties of uterine inertia are described, *primary* and *secondary*; these are really distinct conditions which have nothing in common, but it is convenient to retain the names by which they are usually known.

(1) *Primary inertia* is a condition in which the uterine contractions are ineffectual, the resistances being normal—*i.e.* the fœtus and pelvis are of normal size, and there is no cause of obstruction. The first and second stages are prolonged, and assistance in delivery is frequently required; the third stage is, however, in all respects normal, therefore the function of retraction is adequate, although that of contraction is not. The contractions may be either feeble or partial, or both feeble and partial; the intervals are usually irregular and prolonged. Sometimes the patient complains of almost continuous severe pain, but on palpation only feeble, and often partial, uterine contractions can be felt.

It is met with more commonly in primiparæ than in multiparæ, and is not associated with errors of general health or development. Sometimes a disturbance of the normal mechanism of labour, such as over-distension of the uterus (hydramnios, twins), premature rupture of the membranes, or mal-presentation, appears to induce primary inertia. Frequently, however, no such cause can be discovered, and the condition has then been referred to defective innervation of the uterus, reflex disturbance of the action of the lumbar centre, degeneration of the uterine muscle, &c. Evacuation of the bladder or rectum, when these viscera are full or overfull, often produces a favourable influence, and it is fair to conclude that such conditions may reflexly disturb uterine contractions. Nothing is definitely known of any form of degeneration of the uterine muscle which may cause primary inertia. Unusual nervousness on the part of the patient is often observed, and may possibly in some way disturb the normal innervation of the process.

The results of primary inertia are, as a rule, not serious either to mother or child. If the mother is allowed to remain in constant pain and without sleep for twenty-four hours or longer, she will become greatly exhausted, and such cases have been known to terminate fatally. As long as the membranes remain intact the fœtus will not suffer.

Treatment.—The *first stage* of labour is invariably very prolonged, and the patient's strength and courage must be conserved as far as possible. We possess no reliable means of stimulating uterine contractions at this period; ergot is inadvisable for the reasons stated below; a single dose of

5-10 grains of quinine sometimes appears to be of use, but this drug, although it does no harm, cannot be relied upon to do good. Hot vaginal douches of sterilised water, or a weak antiseptic (115° F.), are of greater service than drugs. The faradic current has sometimes been used with success. The enema or the catheter must be employed when indicated by the condition of the rectum or bladder. A full dose of morphia may be given hypodermically to procure a few hours' sleep, after which labour pains may return and will probably be more effective. Mechanical methods of dilatation should be resorted to if progress is not hastened after sleep.

The *second stage*, if allowed to proceed without interference, will also be very protracted. But it is not necessary to await the expulsion of the child by the natural efforts, if the presentation is a vertex and no cause of obstruction exists; labour may then be terminated by forceps as soon as dilatation of the cervix is complete. With a breech presentation delay may be desirable in the interests of the child.

(2) *Secondary inertia* is in reality *exhaustion* of the uterus; it is marked by a complete cessation of uterine action, bringing the process of labour to a standstill; the functions of contraction and retraction are both in abeyance; in this important respect it differs essentially from primary inertia. The labour usually commences normally with satisfactory or even unusually vigorous pains, but they soon die away, either rapidly or gradually; in other words, the uterus is capable of acting normally at first, but cannot maintain its action for a sufficient time to terminate labour. It may occur at any stage of labour—rarely in the first, more frequently in the second and third; it may also supervene suddenly when labour is entirely over. It occurs almost solely in multiparæ, especially those who have had a rapid succession of pregnancies, and there is no doubt that it depends upon some defect either in structure or in innervation of the uterine muscle; the nature of this defect is, however, unknown. No harm, either to mother or child, follows its occurrence during the second stage, for the head may remain for many hours in the pelvis, when both are of normal size, without injurious effects. After a more or less prolonged interval the pains usually return and labour terminates naturally. When inertia occurs after the expulsion of

the child, serious hæmorrhage results, owing to the fact that the exhausted uterus is unable to retract.

The *treatment* during the first or second stage is to procure sleep by the administration of morphia or chloral. After a period of sleep, uterine pains will probably recur spontaneously, and labour should then be terminated as rapidly as possible or the uterus will again become exhausted. Towards the *end of the second stage* a single full dose of ergot (ʒj. of the liquid extract, or 10♏ of injectio ergotinæ hypodermica) may be given, whether delivery is natural or by forceps, in order to obviate the risk of failure of the uterine muscle during or after the third stage. The temptation to deliver with forceps in the total absence of uterine contractions must always be resisted. It is a cardinal rule of obstetrics that delivery should never be effected by artificial means under such conditions, for the most serious and uncontrollable post-partum hæmorrhage may result from a breach of this rule. The treatment of secondary inertia in the third stage and after labour is considered on page 372.

The Action and Uses of Ergot.—In small doses ergot acts as a general hæmostatic, contracting the calibre of the peripheral blood-vessels; this action is made use of in cases of slight bleeding from the uterus during pregnancy. In larger doses it exerts a specific effect upon the uterine muscle when in action. This effect is to increase the force, duration, and frequency of the uterine contractions and to stimulate retraction. In still larger doses this effect is intensified and the whole uterine muscle passes into a condition of tetanic contraction. Ergot is unable, in any dose, to transform the contractions characteristic of pregnancy into those characteristic of labour; therefore it is useless for inducing abortion or premature labour, and its specific effect is manifested only upon the parturient uterus. It is believed that ergot acts upon muscle by stimulating the peripheral nerve terminations.

It is found, clinically, that the action of ergot upon the parturient uterus is somewhat difficult to control, and there is consequently some risk of producing tetanic contraction by its use except in small quantity. It is, as a rule, withheld until after the expulsion of the after-birth for fear of inducing hour-glass contraction in the third stage (see p. 368); it may, however, be administered towards the end of the second stage as a preventive of third stage or post-partum inertia under certain well-defined conditions as follows: if the presentation is a vertex, the patient a multipara, and no condition likely to cause obstruction to, or delay in, delivery is present. Under these conditions it may be given in secondary inertia, or after prolonged chloroform anæsthesia. After the termination of the third stage, it is useful in multiparæ, in maintaining uterine contraction and promoting the expulsion of blood-clot from the uterus. Primiparæ do not, as a rule, require it after labour, and it should under no circumstances be given to them during the second stage, lest serious laceration of the pelvic floor should occur from too hasty expulsion of the child.

Tonic Contraction of the Uterus.—Uterine tetanus, or tonic contraction, may be partial or complete. The former is unimportant; the latter occurs during labour from three causes: (1) from injudicious administration of ergot; (2) from the unsuccessful efforts of a powerfully contracting uterus to overcome obstruction; (3) from the stimulation caused by repeated unsuccessful attempts at artificial delivery. In the worst instances, the last-named cause is usually found. Tetanus supervenes more or less gradually, the pains increasing in strength and duration, and the intervals progressively diminishing in length. It involves the most serious risks to the mother and child.

Complete tonic contraction is characterised *clinically* by severe and continuous pain, speedily followed by rise of temperature and quickening of pulse. The liquor amnii is completely expelled, the placenta becomes compressed against the body of the fœtus, and the latter will consequently in a short time perish of asphyxia. On abdominal examination the uterus will be found to be tender to the touch and continuously hard, so as entirely to obscure the outlines of the fœtus on palpation. As the fœtus is dead, the heart-sounds have ceased. On vaginal examination the presenting part will be found immovable and covered with a very large caput succedaneum; if the condition has persisted for some time the vaginal and vulval mucous membranes will be found swollen, dry, and tender. Cases so severe as this are seldom met with except where repeated unsuccessful attempts at delivery by version or forceps have been made, the stimulation caused by the repeated introduction of the hand or the instrument into the uterus being the direct cause of the tetanus. If unrelieved, rupture of the uterus may occur; but probably this is not common, for the usual mechanism of production of uterine rupture is essentially different from tetanus (see p. 332).

The *diagnosis* of tonic uterine contraction presents no difficulty; it is impossible, with ordinary care, to mistake it for secondary inertia, a condition in which pains are absent and the uterus is relaxed.

The immediate *treatment* of tonic contraction is to administer a full dose of morphia hypodermically (⅓ gr.–½ gr.) and then to fully anæsthetise the patient with chloroform. It is of the greatest importance to endeavour to overcome the spasm before attempting to deliver. Under the influence of these remedies the tetanus may gradually pass away, and when the uterus has become relaxed labour must be terminated by craniotomy in a head presentation, or by some other destructive operation if the presentation is abnormal (see p. 526). As the fœtus will in all cases have perished *in utero*, only the interests of the mother need be considered. Tetanus will recur if manipulations are begun before sufficient time has elapsed for relaxation to take place.

Over-distension of the Lower Uterine Segment.—This condition is associated with tetanus of the upper active part of the body of the uterus; it is only met with in obstructed labour, of which it forms one of the most striking and important characteristics. It usually leads to rupture of the uterus, and it will be best described in connection with that accident (see p. 331).

Premature Rupture of the Membranes.—When intra-uterine tension is considerably increased during the latter weeks of pregnancy, or when from opening up of the cervix before labour the lower pole of the ovum is unsupported, or when from any cause the chorion and amnion are unusually weak, rupture of the bag of waters may occur before labour has begun. This is known as premature rupture of the membranes. It is met with chiefly in connection with hydramnios or multiple pregnancy, conditions which frequently occur together. The immediate result is escape of the liquor amnii; this usually occurs slowly, but large quantities may be gradually discharged, the flow being usually intermittent, and corresponding with the involuntary uterine contractions. Ultimately labour supervenes; but several days usually elapse before this occurs, and even intervals longer than a week are not very uncommon. If the fluid is in considerable excess, no harm will follow from the escape for several days, for sufficient will remain to protect the fœtus from injurious pressure.

With regard to *diagnosis* one point only requires mention—viz. that after premature rupture of the membranes and escape of a good deal of fluid the examining finger may still detect the presence of a small lax bag of waters below the presenting part. This may be explained by the fact that in such cases the point of rupture is not the lower pole of the membranes, but some point higher up, the fluid escaping from the amniotic sac and finding its way between the chorion and the uterine wall into the vagina. Again, in rare cases, small quantities of fluid may be present between the chorion and the amnion, which may escape by rupture of the chorion, the amnion remaining intact. In this case also a bag of waters will be found, but the quantity of fluid lost in this way is probably always small.

The course of *labour* is usually unfavourably influenced both as regards the mother and the child. Owing to the absence of the natural cervical dilator—the bag of waters—the first stage is prolonged and made difficult (see p. 192). But if a fair-sized bag should remain, this difficulty will be in great part obviated. From the co-incident over-distension of the uterus primary inertia is frequently met with. Infection of the amniotic cavity by pathogenic organisms, present in the vaginal secretion or introduced from without by examination, may occur; the liquor amnii will then become offensive, the fœtus will die, and there will be grave risks of uterine sepsis in the puerperium. The dangers to the child are that the cord or a limb may prolapse, or that the uterus may close down upon it when all the liquor amnii has escaped, and by compression of the placenta lead to death from asphyxia.

Management.—When rupture of the membranes occurs before labour, interference is not immediately indicated, for there is no danger to the child until the whole of the liquor amnii has drained away. In many cases labour will ensue spontaneously within two or three days, although much longer intervals often elapse. The patient should be kept in bed, or at least lying down, and careful abdominal examination should be made daily to determine (1) the amount of liquor amnii which remains in the uterus; (2) the condition of the fœtal heart-sounds. The degree of mobility of the fœtus and the girth of the abdomen (see p. 64) are the best guides to the amount of fluid present; while the heart-rate remains between 120 and 140 no harm from compression need be feared, but a steady or continuous rise or fall of the rate, above or below this level forms an important danger-signal.

It is best to induce labour in two or three days, even if there are no signs of fœtal distress; but this should be done at once if evidence of compression is obtained earlier than this. The best method to employ is the introduction of the Champetier bag; this instrument not only dilates the cervix and excites uterine pains, but also prevents further escape of liquor amnii by plugging the lower segment and cervix. The cervix is usually sufficiently dilated to admit the dilator in these cases, but if not it must be previously dilated to the required size (see p. 484).

Obstructed Labour

This term may be conveniently applied to *cases in which spontaneous delivery through the natural passages is impossible.* A considerable number of different conditions, which may be tabulated as follows, may cause obstruction in labour, although all of them do not invariably produce that result:

I. *Maternal Conditions.*

- Pelvic contraction.
- Tumours of the pelvic bones.
- Ovarian and uterine tumours.
- Undilatable atresia of the cervix or vagina.

II. *Fœtal Conditions.*

- Brow presentation.
- Face presentation with posterior rotation of the chin.
- Transverse presentation.
- Hydrocephalus (when the head is very large).
- Abdominal enlargement (tumours, ascites).
- Locked twins.
- Double monsters.

The greater number of these conditions have been already considered in detail; the remainder may be briefly referred to before passing to the consideration of the clinical results of obstructed labour.

Hydrocephalus.—This condition consists in enormous distension of the cerebral ventricles and the sub-arachnoid space with fluid; as a result the head is greatly enlarged, and the brain-matter exists only in the form of a thin layer. The amount of fluid seldom exceeds three or four pints, but a case has been recorded in which twenty pints were said to have been withdrawn. The head is globular in shape, the face small, the brow protuberant; the cranial bones are thin and soft, the sutures and fontanelles unusually wide (fig. 197). Structural deformities are frequently present in other parts of the body.

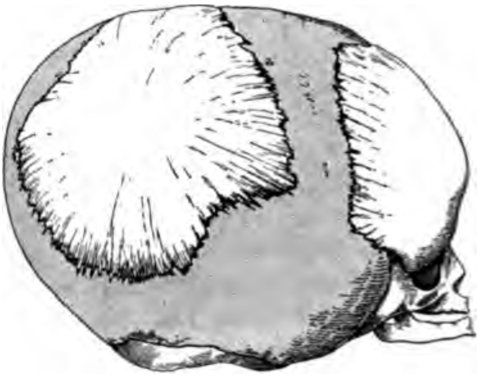


FIG. 197.—THE SKULL IN HYDROCEPHALUS. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Breech presentation is much more frequent in hydrocephalus than when the head is of normal size, as the enlarged head is more readily accommodated at the fundus than in the lower uterine segment. When the head presents, extensive moulding is possible owing to the small size and soft consistence of the cranial bones; spontaneous delivery may therefore occur even when the head is of large size. Moulding does not take place to the same extent with the after-coming head; therefore a breech presentation is less favourable. Diagnosis at the onset of labour often presents difficulty, for, although the head is large, its consistence is soft and on abdominal palpation it may be mistaken for the breech. The width of the sutures and fontanelles, when they can be felt, is, of course, pathognomonic, but after labour has been for some time in progress, and extensive moulding has occurred, the bones of the presenting part of the head loosely override one another, and often arouse the suspicion that the fœtus is macerated.

The treatment consists in perforation of the head, which allows of the free escape of fluid and of consequent reduction in size. If the head cannot be thus reduced sufficiently to pass easily through the pelvis, it may be still further reduced by crushing. In breech presentations an alternative method is to open the vertebral canal in the cervical region and, by passing a trochar into the cranial cavity, to withdraw sufficient fluid to allow the after-coming head to be delivered. In cases of hydrocephalus sufficiently marked to obstruct labour, the survival of the child is undesirable, and the treatment may be regulated solely by the interests of the mother.

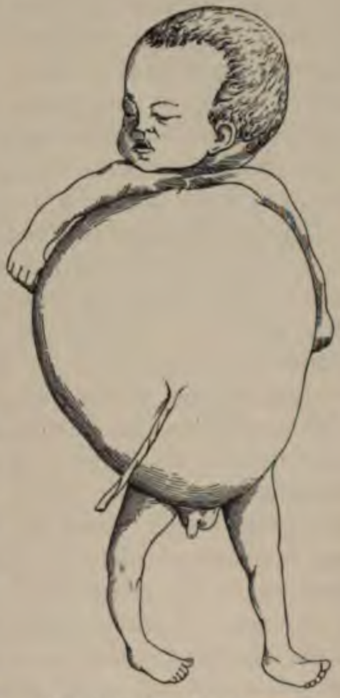


FIG. 198.—FŒTAL ASCITES. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Fœtal Abdominal Enlargement.—The commonest cause of congenital enlargement of the abdomen is *ascites* (fig. 198); rarer causes are over-distension of the *bladder* from urethral stenosis, *cystic tumours* of the *kidney* or the *ovary*, and *syphilitic disease* of the *liver*. An enlarged abdomen may cause insuperable obstruction to the delivery of the trunk; the presenting part—head or breech—is small, and the condition will therefore as a rule be overlooked, until the process of expulsion becomes arrested. Diagnosis can be established by passing the fingers into the vagina, under anæsthesia, and carefully estimating the size and outline of the retained trunk. The treatment is, in the case of fluid swellings, to tap the abdomen, and under all other conditions to eviscerate.

Double Monsters.—These are twin fœtuses developed from a single ovum, and organically united by their trunks; some vital organ, such as the liver, the heart, or one of the great arteries, is always common to the two. The differential diagnosis from locked twins may be very difficult during labour. Being usually small, they do not cause such serious obstruction as would be supposed, and spontaneous delivery may sometimes occur. Decapitation or evisceration may be necessary if the fœtuses are of average size.

Clinical Results of Obstruction.—All of the conditions mentioned above do not invariably give rise to an obstructed labour. The course of labour is greatly influenced by two other factors, in addition to the presence of some cause of obstruction: these are (*a*) the size of the fœtus, (*b*) the strength of the uterine contractions. Thus, many of the fœtal conditions just enumerated will not cause insuperable obstruction if the fœtus is of small size—*e.g.* transverse presentation and locked twins. And, further, a degree of obstruction which would be insuperable to a feeble uterus may be overcome when the uterus contracts powerfully. The influence of the uterine contractions is especially important in the case of vertex presentations in a contracted pelvis, for the moulding of the head necessary for its passage through
e pelvis will not occur unless the uterus acts powerfully.
dingly a multipara with slight pelvic contraction who
en delivered either spontaneously or with the aid of
in her early labours, may suffer from insuperable
n in the later ones, owing to the enfeeblement of

lts of obstruction to labour are extremely serious,
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ger is postponed, at any rate for a time.
contraction will come on, and may lead
the undelivered patient from exhaustion.
bstruction leads to over-distension of the

lower uterine segment, and rupture of the uterus or of the uterus and vagina.

Exhaustion from obstructed labour is characterised by local signs of tonic uterine contraction, rise of temperature, rapidity of pulse and respiration, dry tongue, œdema and arrest of secretion of the walls of the vagina and vulva, and finally delirium or convulsions terminating in death. The signs of *over-distension* of the lower uterine segment will be described in connection with the mechanism of uterine rupture.

From what has been said it will be obvious that early diagnosis of obstruction to labour is required, if the case is to terminate favourably to either mother or child. Therefore reference may once more be made to the importance of systematic examination during the later weeks of pregnancy, and the accurate diagnosis of presentation and of the relation in size of the pelvis and the fœtal head before labour sets in (see p. 72). In the prophylaxis of obstructed labour the importance of this procedure cannot be exaggerated. If this has not been done before labour, no time must be lost in carrying it out as soon as labour sets in. In every case of delayed labour in which the uterine contractions do not appear to be at fault, careful search must be made for causes of obstruction. Unless such causes are discovered before the onset of tonic contraction, or over-distension of the lower uterine segment, the life of the child will be inevitably sacrificed and that of the mother placed in jeopardy. Each case must be considered upon its merits, and treated in accordance with the conditions causing the obstruction.

Rupture of the Uterus

Rupture of the uterus is the most serious accident which can occur in labour. It may take place under varying conditions, and two distinct varieties must be recognised—viz. *traumatic* rupture and *spontaneous* rupture. *Traumatic rupture* is met with in very rare instances in *pregnancy* from direct violence, such as a fall, or a blow or kick upon the abdomen; more commonly it occurs during *labour*, and is due to intra-uterine manipulations such as version, artificial dilatation of the cervix, destructive operations (fœtal), or forceps extraction, performed either unskilfully or under unfavourable conditions. *Spontaneous rupture* is almost unknown except during labour, and may be due to three different conditions. (*a*) It may be due to over-distension of the lower uterine segment from insuperable obstruction. (*b*) It may be due to uterine defects such as malpositions (*e.g.* pendulous belly and anteversion from ventro-fixation), weakening of the uterine wall by cicatrices of previous Cæsarean section, congenital malformations such as bicornute uterus, &c. (*c*) In very rare instances it occurs during normal labour, or sometimes even during pregnancy, with an apparently healthy uterus; the explanation of the accident under these circumstances is obscure, but isolated cases have been reported in which cloudy or fatty degeneration of the uterine muscle, or interstitial myositis, has been subsequently demonstrated.

Multiparity must be recognised as a powerful predisposing cause of both varieties, for in 94 per cent. of cases the victims of this accident are multiparæ. This is explained partly by the weakening of the uterine wall which results from frequent childbearing, and partly from the increased frequency of such causes of obstruction as mal-presentations. The frequency of occurrence of rupture of the uterus is variously estimated at from 1-500 to 1-3,000 labours.

Mechanism of Rupture.—(1) *Over-distension of the lower uterine segment.*—This is the essential cause of spontaneous rupture in all cases due to obstruction. It has been already explained that in normal labour the uterine wall becomes differentiated into an upper active part which retracts as labour proceeds, and a lower passive part which becomes dilated and stretched; separating the two is a well-defined ridge, called the retraction ring, or the ring of Bandl (see p. 190). Sometimes in normal labour this ring can be palpated by abdominal examination in the form of a shallow groove above the level of the pubes. In an obstructed labour—*e.g.* an uncorrected transverse presentation—these changes in the uterus become greatly exaggerated; retraction proceeds to an extreme degree in the active portion, while distension becomes correspondingly extreme in the passive portion, for the reason that the latter is now made to accommodate the greater part of the body of the fœtus (fig. 199). In consequence, the ring of Bandl rises up to, or even above, the level of the umbilicus, and usually runs obliquely across the uterus. The wall of the distended lower segment

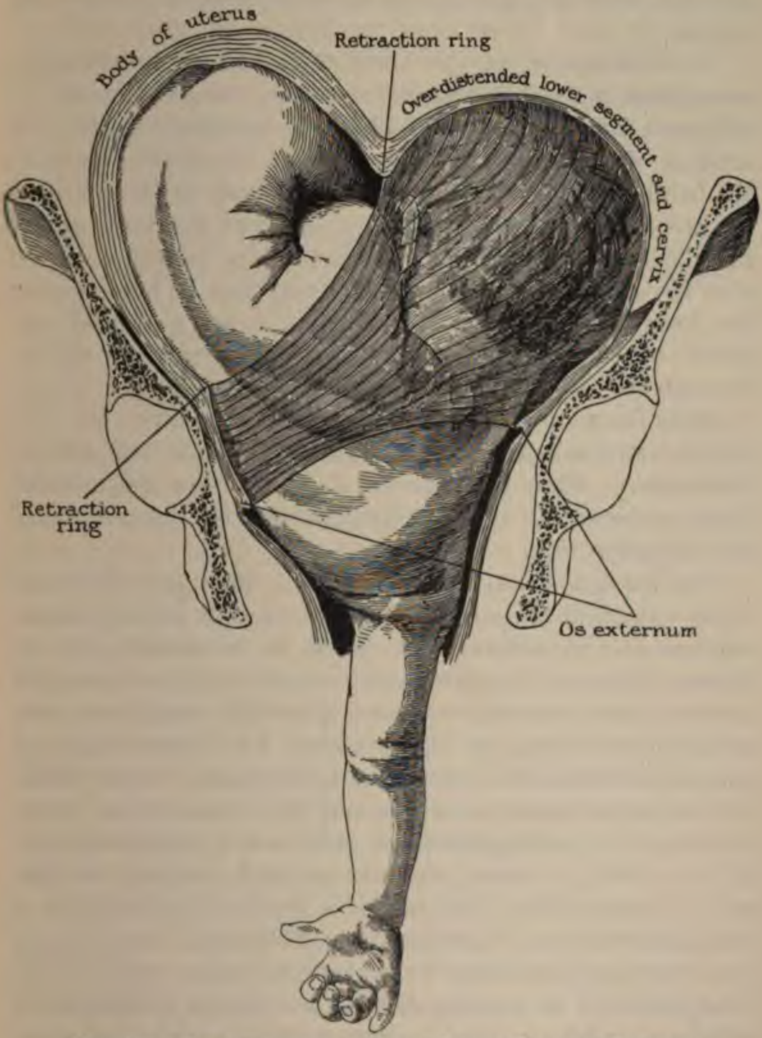

FIG. 199.—OVER-DISTENSION OF THE LOWER UTERINE SEGMENT IN TRANSVERSE PRESENTATION. (BUMM.)

is greatly thinned, especially in the position occupied by the head, and tightly stretched over the body of the fœtus; it is in imminent danger of giving way before the continuous pressure of the active part of the uterus, which is in a state of tonic contraction. Accordingly, rupture produced in this manner always begins in the lower segment, but may extend upwards into the body, or downwards into the cervix and vagina.

Over-distension of the lower segment may be clinically recognised in the following manner: On examination of the abdomen the uterus will be found to be hard and tender; the outlines of the fœtus will be obscure and its mobility limited; the fœtal heart probably inaudible; the ring of Bandl will be recognisable as an oblique groove at about the level of the umbilicus; and one or both round ligaments—tightly stretched over the distended lower segment—may also be felt crossing the front of the uterus in a direction downwards and outwards towards the middle of Poupart's ligament. It will be remembered that these ligaments become considerably hypertrophied during pregnancy. On vaginal examination the conditions found will closely resemble those characteristic of tonic contraction. From the latter condition over-distension of the lower segment can best be distinguished by the position of the retraction ring.

(2) *Intra-uterine Manipulations.*—Such procedures as those named above may, from want of skill or care, cause rupture of the uterus when there is no abnormality in labour; they are, however, much more likely to cause this accident when carried out under unsuitable conditions, such as complete escape of liquor amnii, tonic contraction, or over-distension of the lower uterine segment. Under these circumstances the introduction into the uterus of the hand, or even of a small instrument such as a decapitation hook, is very likely to cause the uterine wall suddenly to give way. Cases of this kind must be regarded as instances of traumatic rupture, for although the condition of the uterus is a powerful predisposing cause, rupture is not spontaneous. Also, methods of rapidly dilating the cervix in labour are always attended by risks of rupture of the cervix and lower segment, for proper regulation of the amount of force employed is very difficult.

In most cases due to intra-uterine manipulations the rupture starts in the cervix or lower uterine segment; thence it runs up into the body and usually follows the lateral uterine wall, opening up the broad ligament. Extensive lacerations may, however, open the peritoneal cavity at once, and numerous cases have been recorded in which a tear has been produced in this way, extending from the fundus above, through the uterine body, lower segment, and cervix, into the lateral vaginal wall.

(3) *Abnormalities of the Uterus.*—Certain abnormal conditions of the uterus may be the cause of spontaneous rupture or may predispose to traumatic rupture. They may be enumerated as follows:

(1) Cicatrices of previous Cæsarean section.
(2) Fatty or cloudy degeneration of the uterine muscle.
(3) Interstitial myositis (uterine).
(4) Bicornute uterus (rarely).
(5) Uterine tumours (carcinoma of cervix).
(6) Misdirection of the uterine axis.

Rupture through a Cæsarean-section scar is usually longitudinal and situated in the anterior wall near the midline; it may, however, be transverse and situated upon the fundus (see p. 522). Conditions (1), (2), and (3) explain the very rare cases already alluded to in which spontaneous rupture of the uterus occurs in pregnancy or in unobstructed labour. Disease of the uterine muscle can only be recognised by microscopic examination of the organ after its removal from the body. When pregnancy occurs in one horn of a bicornute uterus, the non-gravid horn may be found during labour to occupy a position in which it obstructs the passage of the fœtus through the pelvis, and may then lead to rupture from distension of the lower uterine segment. It is extremely rare for uterine tumours to cause rupture.

Misdirection of the Uterine Axis is the chief cause of rupture in cases of 'pendulous belly' (fig. 47); in this condition the axis of the uterus is directed against the posterior wall of the lower uterine segment, and if the displacement is not corrected during labour the presenting part may be driven through the uterine wall at this spot. Extreme lateral obliquity may similarly predispose to rupture. Cases of spontaneous rupture may be also due to previous operations in which unsuitable methods have been employed for fixing the body of the uterus to the anterior abdominal wall, or the anterior vaginal wall. During pregnancy the development of the attached part of the uterus may be greatly retarded, the uterus growing, in point of fact, almost entirely at the expense of its posterior wall, which is consequently very much thinner and weaker than normal at term. There is also marked backward and upward displacement of the cervix, in consequence of which the normal mechanism of parturition is greatly modified.

Morbid Anatomy.—Rupture of the uterus is said to be *complete* when all the coats including the peritoneum are torn, and *incomplete* when this is not the case. Rupture of the lateral wall of the uterus, which in pregnancy is uncovered by peritoneum (see p. 44), may involve the whole thickness of the muscular wall and still be incomplete, as it merely opens up the broad ligament, but does not tear the peritoneum. Further, an incomplete rupture opening up the broad ligament may subsequently become complete by the peritoneal layer yielding, either from the pressure of accumulated blood, from a portion of the body of the fœtus being driven through it by uterine retraction, or from manipulation of the torn parts. Incomplete rupture sometimes involves chiefly the peritoneal coat, occurring in the form of lacerations which gape and may

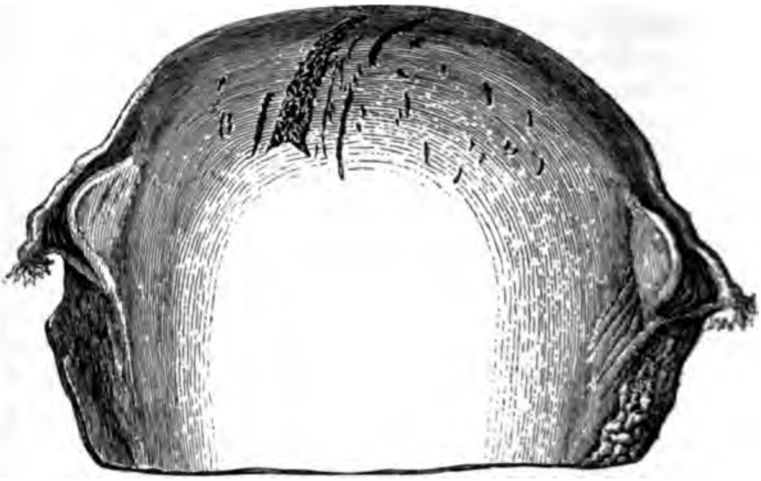

FIG. 200.—INCOMPLETE UTERINE RUPTURE INVOLVING THE PERITONEAL COAT ONLY. (VON WINCKEL.)

bleed freely (fig. 200); the causation of this rare accident is obscure.

Cases of spontaneous rupture are more often complete than incomplete; cases of traumatic rupture are more often incomplete than complete. In the great majority of cases rupture commences in the lower uterine segment, the reason being that this part of the wall is thinnest and is also most liable to over-distension. The rupture may be confined to the lower segment (fig. 201), or may extend upwards into the

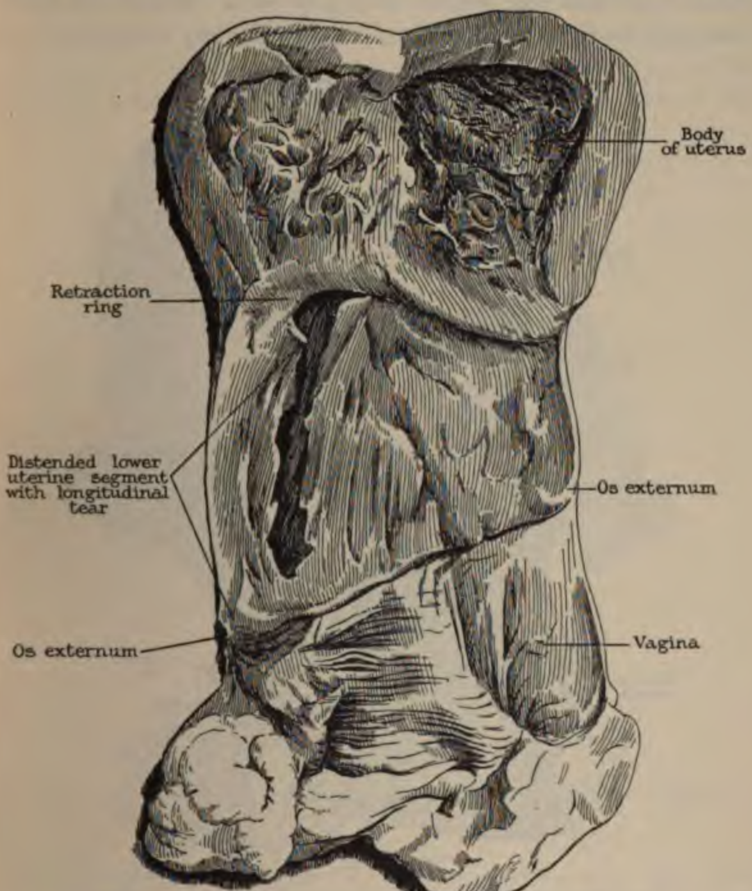

Fig. 201.—Rupture of the Uterus limited to the Lower Segment, which is greatly distended; the Distension is greater on one side than the other. (Bumm.)

uterine body, even to the fundus, or downwards into the vaginal fornices; the bladder is occasionally involved in tears of the anterior wall. In cases due to abnormalities of the uterus, the tear often commences above the lower segment—*e.g.* the scar of a Cæsarean section may give way. The *direction* of the tear is in the majority of cases oblique; occasionally it may be transverse, and sometimes a transverse tear encircles nearly the whole lower segment, practically cutting the uterus in two; occasionally it is vertical, such tears occurring most frequently on the lateral wall of the uterus (fig. 202). In rare instances transverse rupture starts in, and is limited to, the fundus (fig. 203). Fundal rupture in most recorded instances has been attributed to abnormal thinning of the

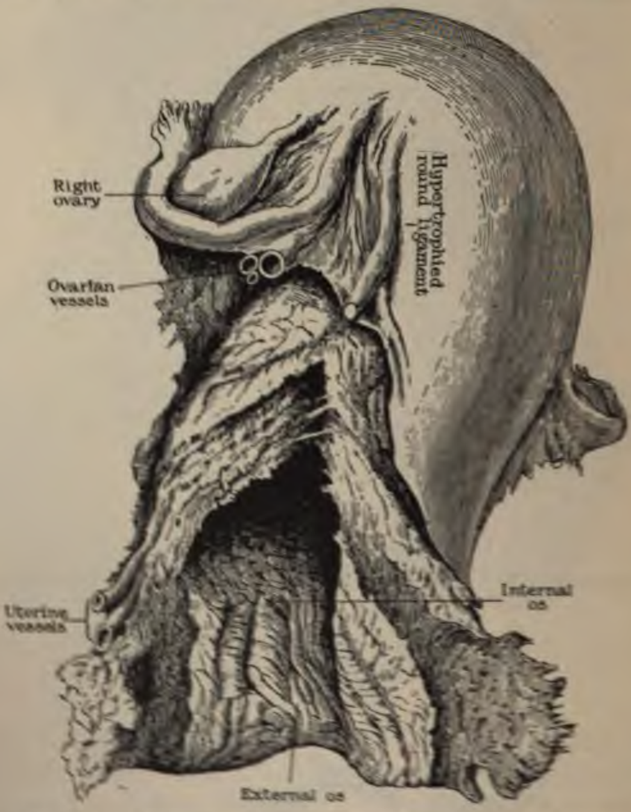

Fig. 202.—Rupture of the Lateral Wall of the Uterus involving Lower Segment and Cervix. (Edgar.)

placental site; it may, however, occur through the cicatrix of a previous Cæsarean section. Sometimes rupture causes laceration of a large branch of the uterine or vaginal artery, or of large uterine veins (fig. 202); serious hæmorrhage then occurs; this is, however, by no means the rule, and if the large vessels escape the amount of hæmorrhage may be trifling. Complete rupture of considerable extent involving the peritoneal coat is usually followed by the escape of the uterine contents (fœtus or placenta, or both) into the peritoneal cavity; the empty uterus then retracts firmly and severe hæmorrhage will be impossible, unless large vessels have been torn. When the rupture is small or incomplete the fœtus remains in the uterine cavity. Sometimes a part only of the fœtus—the head or a limb, escapes through the rupture, the remainder being retained in the uterus; firm retraction of the edges of the rent upon the extruded part may then occur, preventing the withdrawal of the fœtus *per vias naturales.*

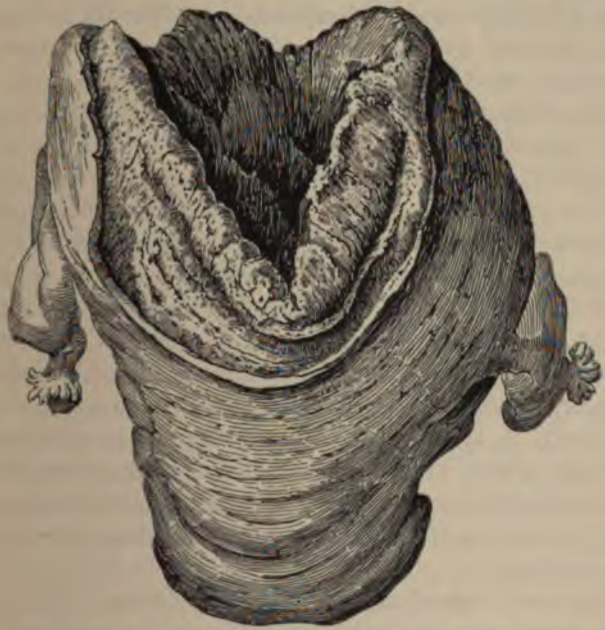

FIG. 203.—COMPLETE TRANSVERSE RUPTURE OF THE FUNDUS UTERI. (VON WINCKEL.)

Diagnosis.—In order to establish the diagnosis of rupture of the uterus, it is usually necessary to recognise the laceration by touch. The symptoms which attend this grave accident are not characteristic, although they may arouse the suspicion that rupture has occurred.

Premonitory symptoms of rupture are sometimes described; these are, in point of fact, the symptoms already mentioned as those of tonic contraction and over-distension of the lower uterine segment (p. 324). But it must be borne in mind that although in the majority of cases a long, difficult, and painful labour precedes rupture, this is not always the case, for spontaneous rupture may occur early in normal labour.

The *attendant symptoms* are probably influenced mainly by the rapidity with which the laceration is produced and the amount of hæmorrhage which accompanies it. Sudden rupture is attended by severe shock and acute abdominal pain, sometimes also by the sensation that something has burst. There may be some external bleeding, but this is seldom, if ever, profuse; the greater part of the effused blood is retained when, if a large vessel has been torn, signs of more or less severe internal hæmorrhage gradually manifest themselves. Occasionally internal hæmorrhage may be so profuse as to cause death in an hour or two. Gradual rupture produces much less severe symptoms, and less profuse hæmorrhage. When the fœtus and placenta escape into the peritoneal cavity, labour pains completely cease; when this does not occur the pains continue.

Abdominal examination yields no certain information unless the fœtus has escaped from the uterus, when the physical signs are striking. The fœtal parts can be palpated with great ease through the abdominal wall; there is also extreme mobility both of the limbs and of the whole body. In the lower abdomen the hard retracted uterus will be found of the size natural to the termination of the third stage of labour, and quite separate from the fœtus. If the fœtus remains in the uterus after rupture has occurred, it is seldom possible to make the diagnosis until after delivery.

In many cases, however, the suspicion of rupture does not arise until after the delivery of the patient, either with or without artificial aid. The placenta may then escape through the rent into the peritoneal cavity, and attempts to deliver it in the ordinary way will be unsuccessful; or considerable external bleeding may occur although the placenta has been delivered and the uterus is firmly retracted; or the patient may show immediate signs of collapse; but in some cases suspicion of rupture has not been aroused for several hours after the termination of labour, owing to the gradual development of the symptoms. Under such circumstances as these, careful search should be made for rupture. If rupture involves the vaginal fornix or the cervix, it will be immediately perceived; if limited to the lower uterine segment, it will only be found by passing one or two fingers into the uterine cavity and carefully exploring the walls. If the placenta has escaped through the rent into the peritoneal cavity, the cord will guide the fingers up to and through the rent. Occasionally a coil of small intestine may protrude through the rupture into the vagina.

Treatment.—This must be considered from two points of view: (1) how to deliver the patient; (2) how to deal with the rupture.

(1) If it is believed, after careful examination, that the fœtus is still in the uterine cavity, an attempt should be made to deliver it through the natural passages; causes of obstruction must be carefully looked for and estimated, and suitable methods of extraction then adopted. If a part of the fœtus has escaped through the rent, attempts at delivery through the natural passages must be very gently made; the extent of the injury may be increased if force is employed to disengage an extruded limb, and as the fœtus is in all cases dead, destructive operations may be practised without hesitation. If the fœtus has been expelled completely into the peritoneal cavity, laparotomy is the only possible method of delivery which can be adopted. If the placenta has escaped from the uterus, it may be drawn down by traction on the cord and delivered with care through the rent.

(2) The treatment of the rupture is regulated by the degree of hæmorrhage which accompanies it, and by the method of delivery which has been practised. In all cases of serious internal bleeding laparotomy should be performed for hæmostasis, if not already indicated as the method of delivery. This allows of the removal of effused blood from the peritoneal cavity, and the rapid and direct control of the hæmorrhage.

If possible the uterus should be preserved; the bleeding points ligatured or under-stitched, and the edges of the rent accurately approximated in the manner described for the operation of Cæsarean section (p. 520). In cases of extensive or contused laceration, or when infection of the uterine cavity is suspected, it is best to remove the uterus by supravaginal or total hysterectomy; in extreme degrees of pelvic contraction this measure may be also called for as the most reliable means of preventing future conception. In considering the question of operation it must be remembered that serious internal bleeding may be in progress although the uterus is well retracted, and the practitioner must not be misled by finding the uterus small and hard. If it has been decided before beginning the operation that the uterus must be removed, vaginal may be preferred to abdominal hysterectomy; the latter, however, permits of more direct and rapid control of the bleeding.

When there is no evidence of serious hæmorrhage, and especially when the laceration, even if complete, is small, the best treatment is carefully to douche the uterus with a mild antiseptic solution, and leave the laceration alone; the peritoneal cavity may also be flushed with normal sterile saline by a tube passed through the rent. Spontaneous union of the tear will occur if asepsis is maintained in the puerperium. It is sometimes recommended that a gauze drain should be passed through the rent into the peritoneal cavity and left for two to three days; this is unnecessary, and has the disadvantage of forming a communication between the peritoneal cavity and the exterior. Lacerations opening the broad ligament are best treated by first thoroughly douching the cavity, and then plugging it firmly with iodoform gauze. Counter-pressure is thus kept up between the walls of the broad ligament and the plug, and moderate hæmorrhage can in this way be controlled. But plugging cannot check hæmorrhage in the case of rents which open the peritoneal cavity, because no counter-pressure can be obtained.

Increased risks of sepsis are, of course, encountered in the puerperium in these cases, and after rupture uterine sepsis entails even graver consequences than after normal labour, for the peritoneum may become infected by direct continuity.

It has been shown that the heavy mortality which attends rupture of the uterus (50 to 80 per cent.) is largely due to sepsis, not to shock or hæmorrhage.

Lacerations of the cervix and vagina frequently occur in labour and are of minor importance. A certain amount of laceration of the cervix is usual in a primipara and requires no treatment; it is invariably longitudinal in direction and usually lateral in position, being much more frequent upon the left than the right side. This is explained by the predominant frequency of the first vertex position, in which the broad end of the head distends the left side of the cervix. Sometimes these lacerations are more extensive and run up to the vaginal roof, or open the base of the broad ligament; they should then be treated by douching the ragged cavity formed by the tear and packing it with iodoform gauze. In extensive rupture of the lower uterine segment the laceration frequently extends downwards so as to involve the cervix and upper part of the vaginal wall.

In severe laceration of the pelvic floor the lower third of the posterior vaginal wall of necessity participates. Vaginal lacerations are thus most frequent in the upper and lower thirds. They may also occur in the middle third in obstructed labour or difficult instrumental delivery; if upon the anterior wall, the base of the bladder may then be lacerated, giving rise to a vesico-vaginal fistula. Sometimes, from prolonged compression between the fœtal head and the pelvic bones, an area of the anterior vaginal wall is damaged beyond recovery, and sloughing occurs. The slough then separates during the first week of the puerperium, and may open the base of the bladder, resulting in a vesico-vaginal fistula. When an extensive area in any position has sloughed, the process of cicatrisation is attended by well-marked constriction, and may result in vaginal atresia of extreme degree. Lacerations of the cervix and vaginal roof do not require suture unless there is considerable hæmorrhage; those of the lower third of the vagina should always be repaired at the same time as the injury to the perineum.

Rupture of Veins (*Vaginal and vulval hæmatoma*).—Large effusions of blood from ruptured veins may form beneath the vaginal walls during labour. The cause of rupture of the vaginal veins is not well known, but the accident occurs chiefly in prolonged labour or operative delivery. It may be also met with in pregnancy as the result of direct injury. The formation of the hæmatoma begins beneath one of the lateral vaginal walls, and usually extends downwards into the labium majus, forming a characteristic vulval swelling which may attain considerable size. Sometimes the tumour does not extend to the vulva, and then it can be recognised only by vaginal examination. The vulval swelling presents distinctive characters; it is soft and fluctuating, of a deep violet colour where covered with mucous membrane, and is associated with subcutaneous ecchymosis, extending over the perineum, around the anus, and upon the inner aspect of the thighs.

A vaginal hæmatoma may form during the second stage of labour, and cause obstruction to delivery; usually, however, it appears during or soon after the third stage. It is associated with severe pain, and the loss of blood from the general circulation may be sufficient to produce urgent symptoms of internal hæmorrhage. Occasionally spontaneous rupture of the hæmatoma occurs, leading to the escape of a large quantity of fluid and clotted blood.

The *treatment* is expectant, with strict antiseptic management of the puerperium. If the thrombus should become infected, it must be laid freely open, the cavity cleared out, douched, and packed with iodoform gauze.

Pelvic Hæmatoma. — The occurrence of hæmorrhage between the layers of the broad ligament in incomplete rupture of the uterus has been already referred to; this condition is called a pelvic hæmatoma. Rare cases have been reported in which the same condition has occurred without injury to the uterus, the source of the bleeding being ruptured veins in the connective tissue of the base of the broad ligament. Such hæmorrhages may be very extensive, dissecting up the whole of the pelvic peritoneum, passing on to the abdominal parietes and into the iliac fossæ, and giving rise to the symptoms of severe internal hæmorrhage. Small effusions which give rise to no urgent symptoms require no operative treatment; but if the patient's condition is urgent, one or other lateral vaginal fornix should be opened, the blood evacuated, and the cavity douched and plugged with iodoform gauze.

Rupture of the Perineum.—This minor accident is of frequent occurrence, but usually of small importance. It is only referred to here in order to emphasise again the importance of examining the perineum in every case after delivery, and of immediately repairing all lacerations which involve more than the skin of the fourchette. Lacerations involving the sphincter ani are of great importance, because, unless successfully repaired, troublesome rectal incontinence will ensue. The chief varieties of perineal rupture, along with the suitable methods of repair, are described upon page 539.

Inversion of the Uterus

This condition is a turning inside out of the uterus. It is one of the rarest complications of labour, being only met with in from 1 in 180,000 to 1 in 200,000 labours. Three degrees of inversion may be described: in the first the placental site—*i.e.* the fundus—is depressed so as to bulge to a greater or less extent into the uterine cavity (fig. 204, *a*); in the second the fundus protrudes through the external os so as to enter the vaginal canal (fig. 204, *b*); in the third the fundus presents at, or protrudes through, the vulva (fig. 204, *c*), the inversion being complete. It occurs either during the third stage of labour or immediately afterwards, but it is highly probable that the process always commences during the third stage, although it may not be recognised until later.

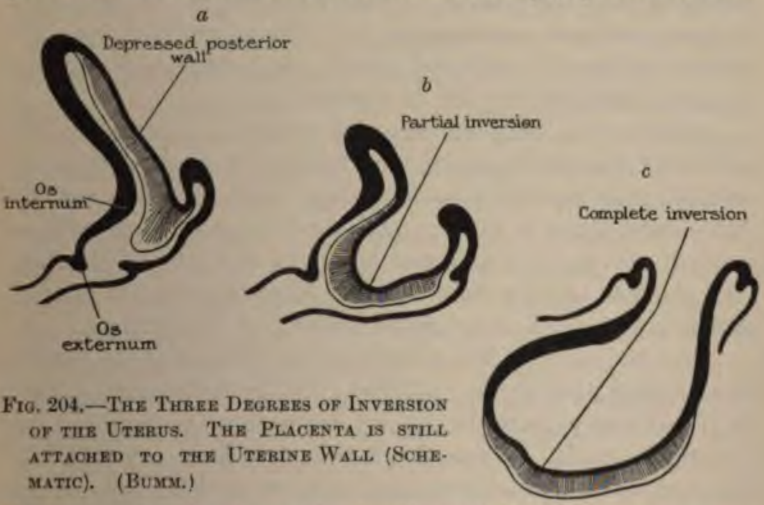

FIG. 204.—THE THREE DEGREES OF INVERSION OF THE UTERUS. THE PLACENTA IS STILL ATTACHED TO THE UTERINE WALL (SCHEMATIC). (BUMM.)

Causes.—Inversion may occur *spontaneously*, or may be *induced* by improper methods of delivering the placenta. When *spontaneous* it may be due to precipitate labour, but the usual cause is atony of the wall of the fundus uteri; by straining efforts on the part of the patient the relaxed area is slightly inverted, and the process then proceeds by the active part of the uterus contracting upon the inverted part and driving it onwards towards the cervix. It is also stated that spontaneous inversion may be started during the second stage of labour by traction exerted upon the placental site through a relatively or absolutely short umbilical cord. (The cord is said to be relatively shortened when coiled round the body or limbs of the fœtus.) It is, however, difficult to believe that traction through the cord upon the wall of an actively contracting uterus could cause inversion.

Inversion may be *induced* during the third stage by endeavouring to deliver the placenta by pressure on the fundus or by traction on the cord, when the uterus is relaxed. It is probable that the process is merely started in this way, and is then carried on spontaneously by uterine contractions. Inversion is usually produced rapidly, but sometimes appears to occupy several days for its completion.

Symptoms.—Pain is a constant symptom. In the second and third degrees well-marked symptoms of shock also occur, and the pain becomes expulsive in character. There is usually hæmorrhage, but it is very variable in amount, and seldom profuse; there may, however, be slight continuous bleeding. The placenta usually remains attached to the inverted fundus, which explains the insignificant amount of hæmorrhage.

The *diagnosis* of this accident is not difficult if the patient is seen soon after it has occurred. In the first degree it may be possible to palpate the fundal depression through the lax abdominal walls. When the fundus has been expelled into the vagina, abdominal examination shows that the body of the uterus has disappeared from its normal position, and the cup formed by the upper end of the inverted organ may sometimes be felt with the fingers; on vaginal examination the firm round swelling protruding through the cervix, and usually covered by the placenta, will then be recognised without difficulty as the inverted fundus. Diagnosis in the third degree is a simple matter when the placenta remains attached; but a number of cases have been recorded in which, the placenta being detached, the inverted uterus has been amputated in the erroneous belief that it was a fibroid polypus. Attention to the abdominal examination should prevent this mistake.

The *prognosis* is grave; death may occur from hæmorrhage or from shock, which may even prove fatal after a reduction of the displacement. In some cases, on the other hand, the condition may remain undiscovered, giving rise to no urgent symptoms; it then passes into the phase of *chronic inversion*, which is dealt with in text-books of gynæcology.

The *treatment* consists in the immediate reduction of the displacement by taxis; the organ should be carefully re-inverted, beginning with the part nearest to the cervix, and gradually returning first the lower part of the uterine wall, and last of all the fundus. The patient is anæsthetised, and one hand is placed upon the abdomen and two fingers are pressed down into the inversion ring so as to dilate and at the same time to steady it, while the organ is gradually replaced with the fingers of the other hand introduced into the vagina. When the displacement has been completely returned, hot intra-uterine antiseptic douches should be given, partly for disinfection and partly to promote uterine contraction. The uterus should be continuously massaged and ergot administered to counteract the tendency which these cases show to inertia, and resulting recurrence of the inversion. In the second and third degrees the placenta should be removed before commencing the replacement, in order to diminish the bulk of the body to be returned through the inversion ring; this is unnecessary in the first degree. Occasionally the uterus cannot be returned by taxis; hot douches should then be used and continuous pressure applied to the inverted uterus by means of Champetier's bag introduced with strict antiseptic precautions into the vagina and distended with air. After twelve to twenty-four hours of continuous pressure, taxis may be repeated and will probably prove successful.

Ante-partum Hæmorrhage

Under this designation may be included cases of uterine hæmorrhage occurring during the last four months (lunar) of pregnancy or in the first and second stages of labour—*i.e.* the period of pregnancy during which the fœtus is viable. As commonly employed, however, this term is limited to cases of *hæmorrhage from the placental site*, and does not embrace such conditions as malignant disease of the cervix or rupture of the uterus, which, it is obvious, might also give rise to bleeding at the same periods. Cases of ante-partum hæmorrhage, thus defined, are divided into two classes, the basis of classification being the situation of the placenta. In one class the placenta occupies the normal position—*i.e.* it is implanted upon the uterine wall entirely above the level of the lower uterine segment; ante-partum hæmorrhage is in this class due to premature separation of the placenta from local or general disease, or from traumatism. In the other class the placenta occupies some part or the whole of the lower uterine segment; ante-partum hæmorrhage in these cases will necessarily occur independently of accident or disease, because the changes which normally take place in the lower segment before and during labour inevitably cause the placenta to be detached from it. The former are known as cases of *Accidental Hæmorrhage*; the latter as cases of *Placenta Prævia* or *Unavoidable Hæmorrhage.* It must be borne in mind that the essential difference between them is the position of the placenta in the uterus, for traumatism and disease are not limited to the class of so-called accidental hæmorrhage, but are quite as likely to affect an abnormally situated placenta as one normally situated.

Causation.—1. We have first to inquire, what are the causes which lead to the *implantation of the placenta in the lower uterine segment?* Recent observations have made it clear that there are two different ways in which it may occur: (1) the fertilised ovum may become imbedded in the lower part of the uterus, instead of, as is usual, at the fundus, when it first enters this organ; this explanation was commonly applied to all cases until a few years ago; (2) after implantation of the ovum in the normal position, the placenta may so develop as to become attached in part to the lower uterine segment. Cases of the first kind are characterised by the formation of the decidua basalis, wholly or partly, upon [illegible]t of the mucosa which covers the lower uterine segment. In cases of the second kind, the placenta is developed in whole or in part, in connection with the decidua capsularis instead of the decidua basalis; as the ovum grows large enough to fill the uterine cavity, decidua capsularis and decidua vera fuse, and a part of the placenta thus becomes attached to the uterine wall over the lower segment. The former may be conveniently called *basal placenta prævia* and is shown in fig. 205; the decidua capsularis can be clearly seen in the upper part of the figure, and it is obvious that the placenta is formed, not upon it, but upon the decidua basalis. The latter may conveniently be called *capsular placenta prævia*, and is shown in fig. 31; here in a three months' ovum it is seen that the decidual space persists, and a portion of the placenta has developed upon the decidua capsularis on either side of the decidua basalis. In this specimen Webster described the part of the decidua capsularis upon which placental formation has occurred, as closely resembling in vascularity and general appearance the decidua basalis adjacent to it. At a later stage of pregnancy a portion of the capsular placenta would lie upon the lower segment and cover the internal os. This part of the decidua capsularis probably fuses firmly with the decidua vera, to which it becomes apposed; accordingly, when detachment of this portion of the placenta occurs, the plane of separation will pass through the well-developed cavernous layer of the decidua capsularis, leading to more or less serious hæmorrhage.

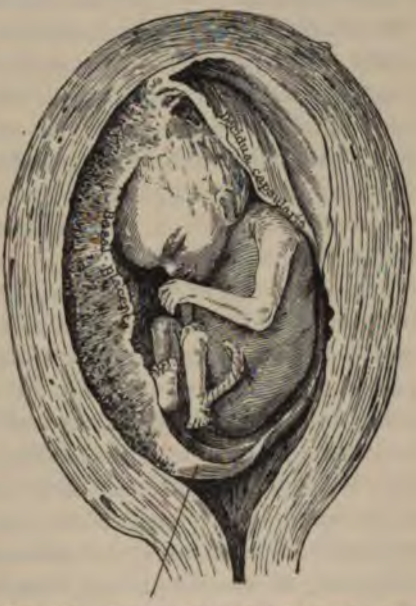

FIG. 205.—BASAL PLACENTA PRÆVIA; THE PART OF THE PLACENTA WHICH IS ATTACHED TO THE LOWER UTERINE SEGMENT IS DEVELOPED UPON THE DECIDUA BASALIS. (WEBSTER.)

It seems probable that further observation will show that cases of complete placenta prævia are always basal; cases of partial or marginal placenta prævia may be either basal or capsular. It is possible that some cases are partly basal and partly capsular.

The explanation cannot be carried further than this; we do not know what are the conditions which lead to the formation of a capsular placenta, or to the original implantation of the ovum upon the lower part of the uterine wall instead of near the fundus. Clinical evidence shows that multiparity, especially when associated with rapid child-bearing, is a powerful predisposing cause; the same is said of endometritis, but upon inconclusive evidence. The placenta itself is frequently abnormal; extensive areas of degenerated villi may often be found (*placental infarcts*), and the cord often has a marginal or velamentous insertion. The nutrition and development of the fœtus are unaffected.

2. With regard to *accidental hæmorrhage* considerable uncertainty still exists as to the relative importance of injury and disease in causing separation of the normally situated placenta. Instances are rare in which it can be attributed solely to direct injury—*e.g.* a kick on the abdomen or a fall; but there is no doubt that such injuries may cause separation of a healthy placenta from its normal attachments. It is probable that a sudden rise in intra-abdominal pressure, produced for instance by an unusual muscular effort or severe coughing or vomiting, may detach the placenta, when local disease weakening its attachments exists, and therefore in these cases both injury and disease are factors in causation. In other cases the hæmorrhage is absolutely spontaneous and must be attributed solely to disease. It is somewhat of a reproach to obstetrics that current knowledge of the nature of the diseases which cause accidental hæmorrhage is so unsatisfactory and incomplete. The most that can be said is that, upon evidence not always convincing, the following are believed to be the most important:

Chronic Bright's disease.
Anæmia.
Purpura.
Syphilis.
Cardiac disease (especially mitral lesions).

Fibroid tumours of the uterus (when submucous or interstitial).

Decidual endometritis.

Disease of the utero-placental vessels.

It must be admitted that, except in the case of chronic nephritis, the evidence that these conditions alone can cause accidental hæmorrhage is inconclusive. It has also been suggested that a very short cord may be the cause of hæmorrhage during the second stage of labour, from traction on the placenta. It is believed that nervous shock may initiate it by exciting a sudden and violent uterine contraction, sufficiently powerful to cause slight separation of the placenta. Multiparity is a powerful predisposing cause, and the great majority of cases occur in feeble and debilitated women. It is accordingly much commoner in hospitals than in private practice.

3. The question next arises, why does ante-partum hæmorrhage always occur when the placenta invades the lower uterine segment, and not when it occupies the normal situation? The answer will be found in the different functions of the upper and lower parts of the body of the uterus. The upper part plays an active *rôle* in labour, undergoing intermittent contractions, and progressive and continuous retraction. The attachment of the placenta to this part of the uterine wall is not affected by the normal contractions of the first and second stages, for although these doubtless entail a slight diminution in the superficies of the uterine wall, this diminution is not sufficient to disturb the placental attachments. Retraction causes more extensive reduction of the superficies of the uterine wall, but until the body of the fœtus has been expelled retraction is only slight in normal labour, and therefore the placenta is able to maintain its attachments. The lower part of the uterus, on the other hand, plays a passive *rôle*; no contractions occur in it, but it gradually becomes stretched during the stage of dilatation so that its superficial area is greatly increased, and its shape altered from that of a section of a hemisphere to that of a cylinder. The placenta is unable to expand in correspondence with the stretching of its site of attachment, and the consequence is that the uterine wall becomes progressively torn away from the placenta, and hæmorrhage then occurs from lacerated

utero-placental vessels. Hæmorrhage is, accordingly, said to be *unavoidable* in placenta prævia.

But how can we account for the occurrence of bleeding *before* the onset of labour, in cases of placenta prævia? It is possible that, in a certain proportion, disease of the placenta or traumatism—direct or indirect—may explain it. In many cases, however, the bleeding appears to be due solely to the abnormal situation of the placenta. A physiological explanation of these cases has been suggested by Pinard—viz. that during the last few weeks of pregnancy the intermittent uterine contractions become gradually stronger (they are certainly more easily palpable), although they remain painless and unperceived by the mother. Upon the lower segment these contractions exercise a dilating force, which may be sufficient to cause slight separation of the placenta and more or less profuse hæmorrhage. In support of this explanation may be cited the clinical fact that a degree of dilatation of the internal os sufficient to admit one finger is met with in the last few weeks of pregnancy, frequently in multiparæ, occasionally in primigravidæ. Webster has suggested an anatomical explanation—viz. that when hæmorrhage occurs before term we have to do with a *capsular placenta prævia*, in which the fusion between decidua vera and decidua capsularis has not been very firm; hence separation of the two decidual layers readily occurs, leading to hæmorrhage.

Morbid Anatomy.—1. *Placenta prævia.*—The extent of the area which the placenta occupies in the lower segment varies, and three degrees are accordingly distinguished: (1) The placenta may occupy the whole of the lower segment, its centre being situated approximately over the internal os; this is called *central placenta prævia* (fig. 206). In clinical practice, cases are called *central* in which the placenta completely covers the os and the margin cannot be reached by the finger. (2) It may occupy approximately one-half of the lower segment, the placenta partly covering the internal os; this is called *lateral placenta prævia* (fig. 207). (3) It may be attached only to the upper part of the lower segment on one side, so as to lie completely above the level of the internal os; this is called *marginal placenta prævia*. It will be obvious that in each variety the placenta to a greater or less extent also overlaps the *safe zone*—*i.e.* the uterine wall above the upper limit of the lower segment. The amount of hæmorrhage met with depends mainly, if not entirely, upon the extent of the placental site which is laid bare in the process of dilatation; accordingly there will generally be the greatest amount with *central*, the least with *marginal*, placenta prævia. And further, inasmuch as the central variety offers a mechanical obstacle both to the expulsion of the fœtus and to the performance of any intra-uterine operation, it is doubly serious.

From clinical evidence there is reason to believe that the wall of the lower segment is unusually weak and friable when the placenta is inserted upon it; no abnormal thinning has been detected in frozen sections, but the development in it of the large sub-placental venous sinuses probably lessens the resisting power of the uterine wall. The practical result is that rupture of the lower segment is very readily caused by intra-uterine manipulations.

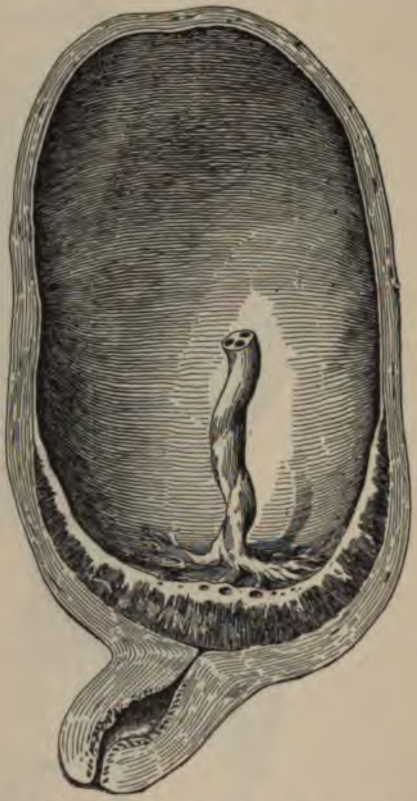

FIG. 206.—CENTRAL PLACENTA PRÆVIA; THE PLACENTA OCCUPIES THE WHOLE OF THE LOWER UTERINE SEGMENT. (BUMM.)

2. *Accidental Hæmorrhage.*—It is rarely the case that the entire placenta is separated from the uterine wall in accidental hæmorrhage, although this occurrence is shown (from nature) in fig. 208; here a very large effusion was formed behind the placenta, which resulted in the death of the patient from internal hæmorrhage. Separation of a portion only of the placenta is, however, quite enough to cause very

severe bleeding. Usually the effused blood escapes under the placental margin and makes its way between the membranes and the uterine wall down to the internal os, whence it passes through the cervix into the vagina. If the hæmorrhage is accompanied by labour pains this will invariably occur, the effused blood being expelled from the uterus by the contractions.

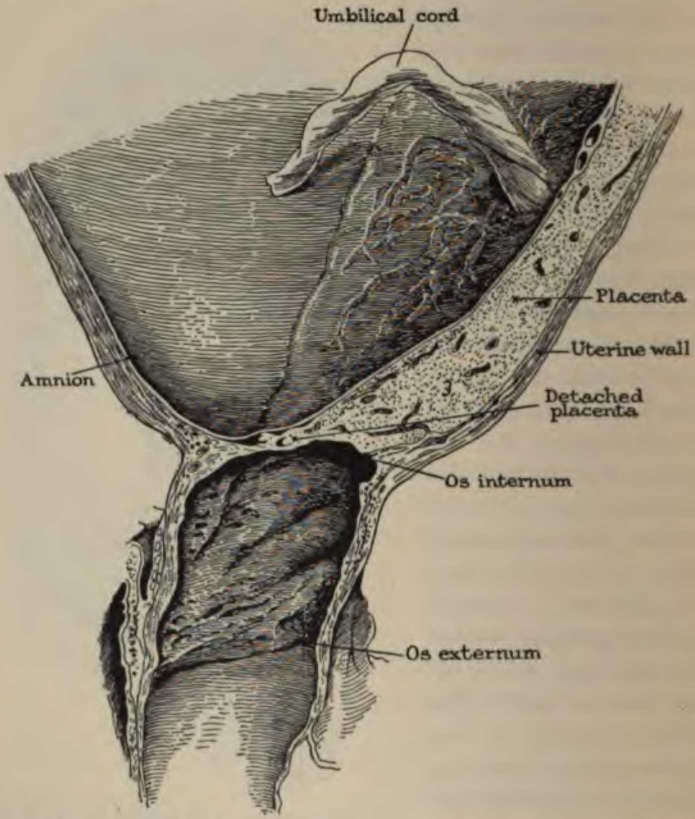

FIG. 207.—LATERAL PLACENTA PRÆVIA; THE PLACENTA OVERLAPS THE OS INTERNUM, WHICH IS PARTLY DILATED. FROM A FROZEN SECTION. (AHLFELD.)

It is, however, not uncommon for retention of blood within the uterus to occur during accidental hæmorrhage, and it will be generally observed that a considerable mass of blood-clot accompanies or immediately follows the expulsion of the placenta in a case of free external bleeding. In very rare instances, however, almost the whole of the effused blood is thus retained, leading to the condition known clinically as *concealed accidental hæmorrhage*. The most important cause of this retention is probably weakness, loss of tone, or loss of excitability of the uterine muscle, which results in complete absence of uterine contractions. Accordingly the uterus

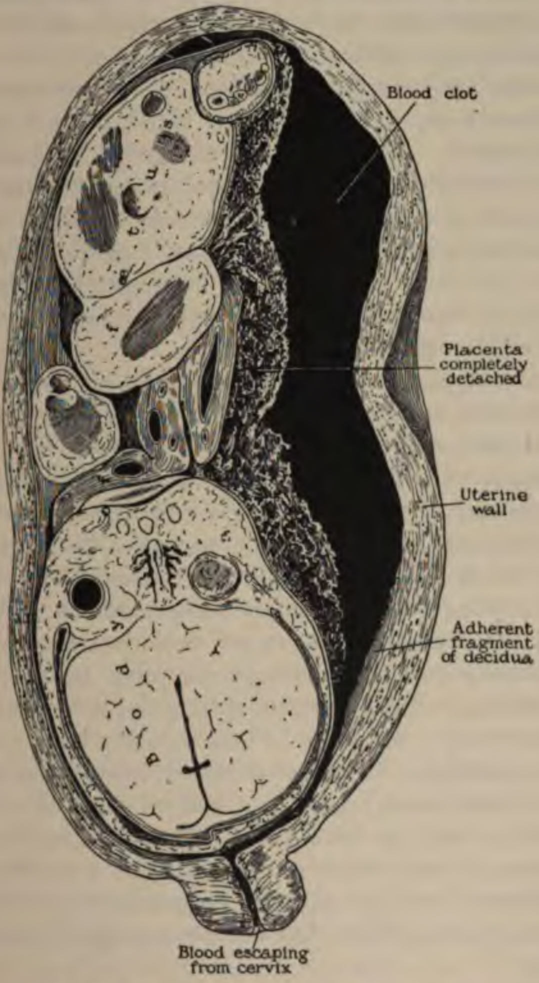
Blood clot
Placenta completely detached
Uterine wall
Adherent fragment of decidua
Blood escaping from cervix

FIG. 208.—CONCEALED ACCIDENTAL HÆMORRHAGE. (VARNIER.)

distends easily to accommodate the effused blood, and in time the muscle becomes completely paralysed from over-distension, and unable to respond to any stimulus whatever. Other conditions may favour the occurrence of concealed hæmorrhage, such as (1) morbid adhesion of the placental margin, leading to the formation of a retro-placental hæmatoma; (2) morbid adhesion of the membranes around the internal os, preventing the blood from entering the cervical canal. Sometimes, in concealed hæmorrhage, the amnion is ruptured by the effused blood, so that bleeding takes place into the amniotic sac; more often it is found between the placenta or membranes and the uterine wall. There is usually a little external bleeding in concealed accidental hæmorrhage (fig. 208). In placenta prævia there is no concealed bleeding.

It will be clear from the above that, in addition to *external* and *concealed* accidental hæmorrhage, a third variety, partly external and partly concealed, may be described.

Symptoms and Influence upon Labour.—1. There is only one symptom of *placenta prævia*—viz. visible hæmorrhage. This symptom may make its appearance in pregnancy, but seldom before the twenty-eighth or thirtieth week, up to which period nothing occurs to indicate the existence of the abnormality. It is possible, but as yet unproved, that earlier than this uncomplicated placenta prævia may lead to abortion. The bleeding is not accompanied by pain, unless labour starts simultaneously; the effused blood is arterial and may be profuse in quantity. The onset is usually spontaneous, and often occurs during sleep; but, as already explained, a history of traumatism may be met with. The first attack may cease spontaneously in a few hours, but there is a marked tendency to recurrence, and by repeated hæmorrhages at intervals of a few days the patient may become exsanguine before labour sets in.

The general course of labour is unfavourably affected by placenta prævia as follows: (1) labour is usually premature, and as the capacity of the lower uterine segment is diminished, the presentation is frequently abnormal; in 352 cases recently recorded by Bürger and Graf the presentations were—vertex 69·2 per cent., transverse 21·1 per cent., breech (all varieties) 9·4 per cent., but the proportion of transverse presentation in this series is probably unusually high; (2) the stage of dilatation is prolonged owing to the deficient formation or entire absence (in central cases) of the natural dilator—the bag of waters; (3) when the hæmorrhage is severe, uterine exhaustion (secondary inertia) may set in; (4) interference is frequently required to arrest the bleeding temporarily or to terminate labour rapidly; (5) consequently there is increased risk of serious laceration of the cervix and lower uterine segment, and, following upon this, of septic infection in the puerperium; (6) the life of the fœtus is jeopardised by premature separation of the placenta, which may cause asphyxia (p. 461), by prolapse of the cord, or by the interference required to terminate labour.

During the first stage of labour hæmorrhage proceeds either continuously or in irregular gushes; or the vagina may become filled up with masses of blood-clot. Towards the end of this stage the hæmorrhage abates, because the presenting part compresses the placental site in passing through the dilated lower segment. During the expulsion of the body of the child it again becomes profuse, for the placenta now becomes completely detached and is usually expelled immediately after the child. Unless secondary uterine inertia sets in, the bleeding then ceases.

2. *Accidental hæmorrhage* is characterised either by *external bleeding*, or by the signs and symptoms of *concealed uterine hæmorrhage*. It is probable that many cases of abortion occurring after the third month are due to detachment, by traumatism or disease, of the normally situated placenta, and these are technically cases of accidental hæmorrhage. It is, however, convenient to restrict this term to cases occurring after the period of viability of the fœtus has been attained. It is therefore obvious that in cases of accidental hæmorrhage, with *external* bleeding coming on during the seventh or eighth month, the symptoms will closely resemble those of placenta prævia. Even if a history of traumatism is obtained, it does not necessarily follow that the case is one of accidental hæmorrhage; the differential diagnosis can only be made in the manner to be described later on.

In *concealed* accidental hæmorrhage we have one of the most serious accidents that can possibly happen to a pregnant woman. In a severe case there is a fairly characteristic train of signs and symptoms, which are due to two factors: (1) loss of blood, (2) over-distension of the uterus. The general symptoms caused by internal bleeding have been referred to in connection with tubal pregnancy (p. 132), and need not be described again. The occurrence of concealed hæmorrhage may be sometimes diagnosed by noting, in an apparent case of external hæmorrhage, that the degree of constitutional disturbance is disproportionate to the amount of blood lost. In a severe case of concealed bleeding the constitutional disturbance is profound. Over-distension of the uterus causes severe, continuous, and increasing abdominal pain, combined with shock. The uterus itself increases rapidly in size, and in a few hours may become large enough to displace the diaphragm and embarrass the respiration. On examination *per abdomen* it will be observed that the uterus is very large, very tense, very tender, and almost wooden in consistence; no contractions can be felt; the fœtal parts cannot be detected nor the sounds of the fœtal heart heard. On vaginal examination a little bleeding from the uterus will be usually detected, although in rare cases there is none. The cervix may be closed—*i.e.* there may be no sign of labour, or slight dilatation may have occurred. The temperature will be subnormal, the pulse will be rapid—over 120; there will be pallor or absolute blanching of the skin and mucous membranes.

Clearly a certain resemblance exists between this condition and tonic uterine contraction (see p. 324). In concealed hæmorrhage, however, the uterus is larger than normal, but in tonic contraction it is smaller; and while signs of internal hæmorrhage are conspicuous in the former, they are absent in the latter. Lastly, in tonic contraction the cervix is always considerably dilated. Accordingly, errors in diagnosis need not occur.

In external accidental hæmorrhage the course of labour is unfavourably affected, in very much the same manner as in placenta prævia. But much greater variation in the amount of hæmorrhage is met with in the former than in the latter; many cases of accidental hæmorrhage are trivial, but placenta prævia is nearly always serious. Labour is usually premature; tedious from primary or secondary uterine inertia; dangerous to the mother on account of loss of blood, and on account of the frequent necessity for operative interference;

dangerous to the child from risks of asphyxia by premature separation of the placenta, or of injury during intra-uterine operations. Before labour accidental hæmorrhage shows the same tendency to recurrence as placenta prævia. *Concealed* accidental hæmorrhage is invariably accompanied by complete paralysis of the uterine muscle; the cervix is usually undilated, and not only are there no spontaneous uterine contractions, but it is extremely difficult to obtain any response to the ordinary methods of excitation.

Differential Diagnosis.—The differential diagnosis between placenta prævia and accidental hæmorrhage can only be made by recognising in the former that the placenta occupies the lower uterine segment. It is said that this may sometimes be done by palpation and auscultation *per abdomen*, but this is doubtful. When the cervix is closed it may be surmised that the placenta occupies the lower segment from the consistence of the uterine wall as felt through the vaginal fornices; an unusual extent of soft boggy resistance may here be felt, obscuring the presenting part and making ballottement difficult. The presence of the placenta in the lower segment interferes with the descent of the presenting part, and renders engagement of the head in the brim before labour impracticable. If, therefore, the head is found engaged, the case is probably one of accidental hæmorrhage. The only conclusive method is to pass the finger through the internal os, when the placental tissue can be recognised by direct touch. A little care is required to distinguish retained blood-clot from placental tissue, the much greater friability of the former being the chief point of distinction between them. This method is, of course, only applicable when the internal os has begun to dilate; but after a severe hæmorrhage there is usually sufficient dilatation, even during the last few weeks of pregnancy, for the diagnosis to be made in this manner; during labour no difficulty will be encountered except in marginal cases when the placental edge may lie beyond the reach of the finger. When the placenta cannot be felt in the lower segment, the case must be regarded as one of accidental hæmorrhage. Cases of concealed hæmorrhage are never due to placenta prævia.

Treatment before Labour.—Before labour, slight cases of *accidental hæmorrhage* should in the first place be treated by palliative measures. Complete rest in bed for several days should be enforced; light diet without stimulants, and a daily aperient, should be enjoined. Sedatives will be indicated in most cases, bromide of potassium or some form of opium being undoubtedly the most useful. Ergot has been advised in small doses—10–20 ♏ of liquid extract three times a day; but it is very doubtful whether it exerts any appreciable effect. Recurrence of bleeding does not necessarily take place, and even when labour occurs there may be no more hæmorrhage. After a single severe hæmorrhage has taken place, labour should be induced; but when the initial separation of placental tissue is extensive, labour often occurs spontaneously, unless the uterine muscle becomes paralysed from over-distension. In less severe cases palliative treatment should not be continued when it fails to prevent recurrence of bleeding.

In the case of *placenta prævia*, the same line of treatment may be adopted if the patient can be kept under continuous observation, or if circumstances permit of assistance being at all times immediately available, in the event of a serious recurrence of bleeding. Otherwise, labour should be at once induced, for in placenta prævia the recurrence of bleeding either before or during labour is inevitable, while in accidental hæmorrhage it is not.

When it is necessary to induce labour, the choice of method will be guided mainly by the urgency of the case, a slower or a more rapid method being adopted according to circumstances (see p. 480).

Management of Labour.—The management of labour complicated by ante-partum hæmorrhage must be guided by the following principles: (1) in cases of severe bleeding the hæmorrhage should, if possible, be temporarily arrested while time is gained for delivery; (2) permanent arrest of the hæmorrhage can, however, only be ensured by complete evacuation of the uterus—therefore, when the hæmorrhage is uncontrollable, delivery must be effected as rapidly as possible; (3) in urgent cases the chances of the child surviving are so slight that treatment may be directed solely to the interests of the mother.

Temporary arrest of hæmorrhage is much more practicable in placenta prævia than in accidental hæmorrhage; in the former the placental site in the lower uterine segment is accessible from the vagina, and may be subjected to compression in various ways; in the latter the placental site cannot be localised and is inaccessible to compression. The effect of uterine contractions in the two cases is also different: in placenta prævia the lower segment is progressively dilated, and the placental site progressively denuded by the uterine contractions, which accordingly tend to increase the bleeding, until that part of the placenta which occupies the lower segment is completely detached; in accidental hæmorrhage each contraction temporarily diminishes the maternal blood-flow to the placental site, and accordingly tends for the moment to check bleeding. Uterine contractions are, in point of fact, the only means we possess of temporarily controlling accidental hæmorrhage, and treatment is therefore directed to exciting them to the greatest possible activity. In both varieties of ante-partum hæmorrhage, elevating the foot of the bed for ten to twelve inches is believed to check the bleeding slightly and is usually practised.

I. **Placenta prævia.**—Cases which are seen early in labour may be treated in the first place by one or other of the following methods:

A. *Plugging the Vagina and Cervix with Gauze.*—This procedure has been described on page 157. It is a suitable method to adopt at the onset of labour when there is only slight dilatation of the cervix (internal os admitting one finger). The vaginal plug excites uterine contractions, and thus promotes the advance of labour; it also provides for compression of the placental site, not continuously, but during the pains. When the presenting part is driven into the lower segment, and counter-pressure is offered by the vaginal plug, the placental site is compressed between the presenting part and the plug. In head presentations this method is of course more successful than in presentations of the breech, since the head fills the lower uterine segment more completely. Full dilatation cannot be obtained by this method alone.

B. *Plugging the Lower Segment with the Half-breech.*—This method is the best to adopt when the cervix is sufficiently dilated to admit two fingers. If the head or shoulder presents, external or, if this is impracticable, bi-polar version must first be performed (see p. 495); if the breech presents, version is of course unnecessary. If the external method can be [illegible] nearly [illegible] placenta [illegible] with the [illegible] in the [illegible] straight.

[illegible]

[illegible]

cord does not become prolapsed. After this manœuvre delivery should not be hurried, but allowed to proceed naturally, unless uncontrollable hæmorrhage should set in. When applied promptly, this method offers a very fair chance of the case terminating favourably to the mother, for not only does it arrest bleeding, it also greatly accelerates the progress of labour by stimulating contractions and promoting dilatation. There is, however, some danger to the child from compression of the cord, and from premature attempts at respiration.

C. *Plugging the Lower Segment with a Hydrostatic Dilator* (Champetier bag).—The use of this appliance will be described on page 484. This method is to be regarded as an alternative to the last mentioned; it will be obvious that its mode of action is much the same. The membranes should first be ruptured and the dilator then introduced into the amniotic sac; if this is not done, and the dilator is placed between the membranes and the uterine wall, it causes extensive separation of the placenta before pressure can be brought to bear upon the placental site. When in position, traction can be made upon the lower end of the bag so as to keep up continuous pressure. The patient must be carefully watched when this method is adopted, for profuse bleeding may follow the expulsion of the bag from the cervix into the vagina, if the presenting part does not closely follow it so as to compress the denuded placental site. It will be remembered that there is reason to believe that the lower uterine segment is unusually weak in cases of placenta prævia, and a certain number of cases of spontaneous rupture of the uterus during the use of this bag have been reported. The bag is inferior to the half-breech in one particular—viz. when its dilating effects have been fully produced, some additional form of interference will in almost all cases be required to deliver the child, whereas with the half-breech dilatation and delivery proceed *pari passu*. In cases of head presentation, however, the bag has this advantage, that preliminary version is not required. Its introduction is easier than the operation of bi-polar version, but if external version can first be performed, it is extremely simple to reach and pull down the leg, after rupturing the membranes.

In comparing procedures B and C, it may be said that the former involves less risk to the mother, while the latter offers the better chance to the child.

D. *Rupture of the Membranes.*—This method is very useful when the head presents, the placenta is marginal or lateral, and the amount of bleeding slight. Free escape of the liquor amnii permits the presenting part to descend completely into the lower uterine segment and fill it so as to compress the placental site; at the same time the force and frequency of the uterine contractions are increased. Care must be taken that a loop of cord does not become prolapsed. It has the advantage of simplicity, but is not so efficacious as B and C. If the breech presents it is inadequate, and if the shoulder presents it is contra-indicated.

When full dilatation of the cervix has been obtained by any of these means, delivery should be immediately effected by forceps (head presentation), version (transverse), or extraction (breech). If the cervix resists dilatation, or the hæmorrhage cannot be controlled, delivery must be effected by one of the methods of rapid dilatation (see p. 484). If sufficient dilatation cannot be obtained to allow of extraction without craniotomy, this may always be done when it is clear that the child is dead, or when the mother's condition is too serious to brook further delay.

The management of labour with placenta prævia may be summed up as follows:

(1) Cervix is sufficiently dilated to admit one finger—plug the cervix and vagina.

(2) Cervix admits two fingers or more, and hæmorrhage is slight—rupture the membranes if head presents, pull down a leg if breech presents.

(3) Cervix is in the same condition and hæmorrhage is severe—bi-polar version or Champetier bag if head presents, pull down a leg if breech presents.

(4) Cervix is one-half or more dilated and bleeding continues—complete dilatation with fingers and deliver by forceps (head) or traction (breech).

The *third stage* of labour requires very careful management, owing to the serious risk of post-partum hæmorrhage from inertia which attends placenta prævia. All necessary preparations must therefore be made for dealing with this serious complication.

II. Accidental Hæmorrhage.—1. *When the hæmorrhage* [illegible]*ternal.*—In the early stages of labour, the cervix being closed or only large enough to admit two fingers, two methods of treatment are applicable—viz. vaginal plugging and rupture of the membranes. The former is the method introduced and advocated at the Rotunda Hospital, Dublin, and now generally accepted and practised. The object in view is twofold—firstly, to stimulate the uterus and so induce effective labour pains; secondly, to prevent further escape of blood from the uterus. The vaginal plug does not directly control bleeding, as in the case of placenta prævia; but it is claimed for it that, by preventing the escape of the effused blood, when the uterus is actively contracting, the intra-uterine pressure will be raised to a point at which it equals or exceeds the blood-pressure in the placental sinuses, and accordingly the bleeding will cease spontaneously. This effect will not be produced unless, at the same time, the plug excites effective uterine contractions. The plugging is carried out as follows: After thorough antiseptic douching, the vaginal canal is tightly plugged from the fornices to the vulva with strips of antiseptic gauze; an abdominal binder tight enough to compress the uterus is next applied; finally a large pad of wool is placed over the vulva, and a bandage carried tightly from the binder behind, over the vulval pad, and fixed to the binder in front. Full doses of ergot are also given by the mouth. Unruptured membranes are of great assistance in maintaining intra-uterine tension. If uterine contractions are not powerfully excited, this treatment may convert the case into one of concealed hæmorrhage by preventing the escape of effused blood. This untoward result does undoubtedly occur, but experience shows that it is very rare.

Rupture of the membranes is the other alternative at this stage; its object is to excite effective contractions and thus accelerate labour. This effect is, however, less certainly produced than by vaginal plugging. It should only be used at this stage if the bleeding is slight or has ceased, and the amount of blood which has been lost is inconsiderable. Before rupturing the membranes a head presentation should be produced by external version if any other part presents. Afterwards a tight abdominal binder should be applied, and full doses of ergot given until effective pains have been excited.

In later stages of labour, when the cervix is from one-third to one-half dilated, dilatation should be completed by the

Champetier bag, and delivery effected by forceps or version. Methods of dilatation more rapid than this are undesirable except in extreme cases, when *accouchement forcé*, aided by craniotomy, may be required (see p. 493).

2. *When the hæmorrhage is concealed.*—In severe cases of concealed hæmorrhage there is complete uterine inertia, and it is almost impossible to induce *effective* labour pains owing to paralysis of the uterine muscle from over-distension. Two lines of treatment have to be considered, and the choice is often difficult, requiring great care and judgment. (1) The vagina may be plugged and a binder applied, in the hope of exciting pains, and the attention then devoted to restoring the patient's strength by administration of stimulants, saline enemata, or saline transfusion. In the absence of skilled assistance, and in surroundings unsuitable for serious operative measures, this is probably the best treatment to pursue. (2) When the circumstances are favourable for the performance of a major operation, Cæsarean section is the best treatment, followed by hysterectomy if owing to inertia proper retraction of the empty uterus cannot be secured. As may be expected, a high maternal mortality attends this very serious condition, by whatever method it may be treated.

Non-expulsion of the Placenta

The natural expulsion of the placenta may be prevented (*a*) by uterine inertia, (*b*) by morbid adhesion of the placenta or membranes to the uterine wall, or (*c*) by irregular uterine contraction ; in all these conditions severe hæmorrhage may occur unless the placental attachments remain undisturbed. If the placenta retains its complete attachments undisturbed there will be little hæmorrhage, for none of the utero-placental vessels have been torn ; when, however, it is in part but not wholly detached, and the uterus is unable to expel it into the cervix, uterine retraction is impeded and free bleeding occurs from the imperfectly closed mouths of those vessels which have been torn. Though the normal processes of separation and expulsion of the placenta and membranes are always accompanied by hæmorrhage, the amount does not usually exceed four to six ounces, and is not enough to quicken the pulse-rate or affect the general condition of the mother.

Unusually free bleeding at this period (third stage) is always due either to *incomplete detachment* of the placenta or to *laceration* of some part of the genital canal—the cervix, vagina, or vulva. The latter will be considered in the next section in connection with post-partum hæmorrhage.

(1) *Retention of the Placenta. Uterine inertia.*—In this condition spontaneous delivery of the placenta does not occur, and the after-birth remains in organic union with the wall of the uterus, although its attachments are not abnormal. The cause of the non-detachment of the placenta, whether partial or complete, must be inadequacy of uterine retraction and contraction, for no abnormality can be detected in the placental attachments. Sometimes no hæmorrhage occurs; more frequently a portion of the placenta becomes separated, and then there is hæmorrhage, which may be of large amount. A practitioner in a hurry may be tempted to diagnose *retention* whenever the placenta is not expelled within a few minutes after the delivery of the child; this is unjustifiable, and at least an hour should be allowed to elapse, unless there is unusual hæmorrhage, before the case is regarded as abnormal. When there is no hæmorrhage the condition is not urgent, and delay can do no harm; if there is much hæmorrhage no delay can, of course, be allowed. If the placenta cannot be expressed (see p. 235) the treatment consists in digital removal of the after-birth from the uterus. In the case under consideration, no difficulty whatever attends the detachment of the placenta, showing that there is no structural abnormality. But the operation, though simple and easy, is attended by definite risks, and should never be undertaken merely to save time.

(2) *Morbid Adhesion of the Placenta.*—The pathology of this condition is imperfectly understood. Clinically it is characterised by unusual firmness of the placental attachments, in consequence of which spontaneous delivery is rendered impossible. It is rare for the whole placental site to be thus affected; usually the change is partial in extent. It is attributed, and with probability, to inflammatory changes in the decidua, resulting in the formation of more or less extensive firm organic connections with the uterine wall. From this view it is easy to proceed to the assumption that some form of decidual endometritis is the original lesion; and this assumption is supported by the observation that the

condition not infrequently recurs in successive pregnancies. But pathological proof has not yet been advanced, because it is difficult to obtain material in a suitable condition for histological examination, inasmuch as the placenta, in these cases, is usually obtained in fragments torn from the uterine wall.

Morbid adhesion of the placenta may cause severe hæmorrhage in the third stage, but sometimes there is little or none. The amount of bleeding depends mainly upon the extent of the adherent area; when this is large, only a small part of the placental site can be laid bare—*i.e.* can give rise to hæmorrhage; when the adherent area is small a large extent of the placental site may be denuded and thus cause severe bleeding.

Simple *retention* and *morbid adhesion* of the placenta can only be distinguished from one another by digital separation of the after-birth. In the former condition this is easy; in the latter it is difficult owing to the presence of dense fibrous bands which must be torn through, or owing to close union between the placental and uterine surfaces. The treatment of a morbidly adherent placenta is the same as of a retained placenta—viz. to remove it by digital manipulation (see p. 370).

(3) *Morbid Adhesion of the Membranes.*—When this occurs, the placenta, though expelled from the uterine cavity, remains suspended in the cervix or vagina by non-separation of the chorion from the uterine wall, and cannot be delivered by voluntary expulsive efforts or by gentle compression. Abdominal examination shows that the placenta has left the uterus, and the diagnosis is consequently easy. If energetic compression of the uterus is practised the placenta may be torn away and expelled with the amnion, leaving the chorion in the uterus. Digital detachment of the adherent membranes should be practised, the fingers being passed up into the uterus at the sides of the placenta. Whenever a considerable proportion of the chorion has been retained in the uterus it must be removed at once; small fragments, however, may be allowed to remain and will be expelled spontaneously during the puerperium.

(4) *Irregular Uterine Contraction* (Hour-glass contraction).—This rare condition is the result of local spasm of

the uterine wall greatly narrowing the lumen of the uterus and preventing the expulsion of the placenta. The upper part of the uterine body, which, though retracted, is lax and contains the placenta, is separated by a ring of spasm from the lower segment and cervix, which are also lax; hence the name of hour-glass contraction which has been applied to it (fig. 210). The site of the spasm is in all probability the retraction ring. The condition occurs after prolonged or difficult labour, but the administration of ergot before delivery, at one time regarded as the principal cause, has probably little to do with its causation.

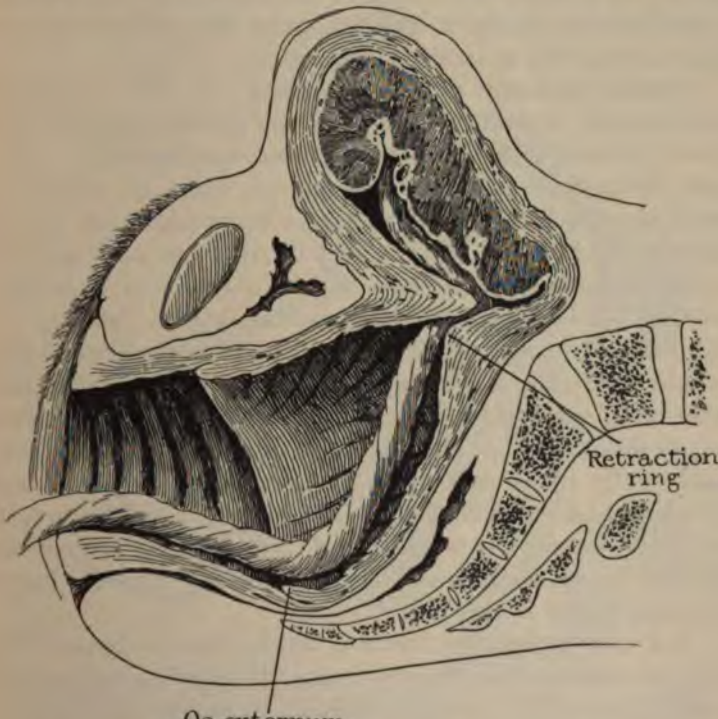

FIG. 210.—IRREGULAR RETRACTION OF THE UTERUS (HOUR-GLASS CONTRACTION). (AFTER BUMM.)

If the placenta becomes partly or wholly separated there will be severe hæmorrhage, for its expulsion through the ring of spasm is impossible; if not, there will be none. In the former case immediate removal of the placenta is called for; in the latter, it is best to wait for two or three hours before attempting removal, in order to get rid of the local spasm; this may also be aided by the administration of morphia. Considerable difficulty may be experienced in dilating the ring of spasm, if the operation has to be undertaken immediately.

Sometimes the presence of a fibroid tumour in the lower part of the uterine wall will offer the same kind of obstacle to spontaneous expulsion, and the same kind of difficulty in artificial delivery, as irregular retraction.

Digital Removal of the Placenta.—In this operation an anæsthetic should be given, and the patient placed in the dorsal position with the legs supported by attendants. The most scrupulous antiseptic precautions must be taken in sterilising the hands and vulva, and in avoiding, as far as possible, contact with the pubic hair; the use of a pair of previously boiled rubber gloves is also strongly to be recommended. A hot (115° F.) intra-uterine douche (lysol ℥j. to Oij.) should be prepared for administration at the close of the operation. Either hand may be passed into the vagina, the other being employed to steady and depress the uterus. The fingers should be bent into the shape of a cone, and the whole hand gently introduced through the vulva, the labia being separated and the pubic hair held away with the fingers of the other hand; the whole hand may then be passed up between the membranes and the uterine wall until the lower placental border is reached.

In a case of simple *retention* it will be found to be perfectly easy to insinuate the fingers under the placental edge, and gradually detach it from the uterus, the fingers sweeping the wall on both sides (fig. 211). This should be continued until the whole of the placenta has been completely detached; then the mass is grasped in the fingers and gently withdrawn into the vagina, the membranes being peeled off behind it. The fundus is steadied by the other hand pressed upon it until the operation is finished. It is important to fully detach the placenta before beginning to remove it, otherwise fragments may easily be torn off and left behind. After the placenta has been removed it should be examined immediately, and if it or the membranes are incomplete the hand must again be introduced. A hot intra-uterine douche should then be administered to stimulate retraction and remove clots, and to counteract the possible effects of the introduction of air or impurities. A dose of ergot should be given, and it is important to make sure that the uterine cavity is completely empty, as described on page 237. Carelessness in performing this operation may result in perforation of the uterus, incomplete removal of the placenta, or troublesome

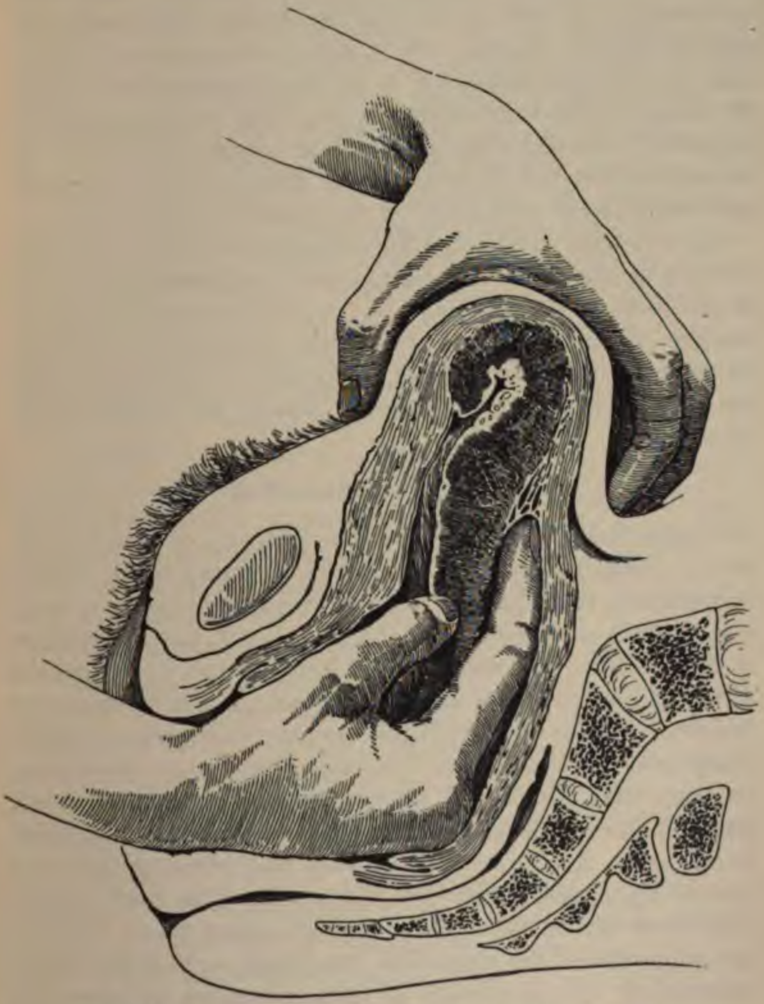

FIG. 211.—DIGITAL REMOVAL OF THE PLACENTA. (BUMM.)

hæmorrhage; failure of antiseptic technique may lead to sepsis in the puerperium.

When there is *morbid adhesion* of the placenta, difficulties will be encountered. In this case it is best to begin with the detached portion, if this can be found. The finger-tips must be used in clearing the uterine wall, and great gentleness is of course called for in all the manipulations. The use of the curette is inadmissible, but blunt ovum forceps may be used to seize and detach portions of placenta which cannot be separated by the fingers. Every effort should be made to completely remove the whole of the placenta and chorion.

In *irregular retraction* the difficulty consists in dilating the ring of spasm sufficiently to admit the fingers and allow of the removal of the placenta. A full hypodermic dose of morphia given beforehand assists the anæsthetic in relaxing the spasm. Dilatation should, if possible, be performed with the fingers alone, but mechanical dilators have been found necessary.

Post-partum Hæmorrhage

Hæmorrhage which occurs after delivery is called post-partum hæmorrhage; its occurrence is most to be feared immediately, or within an hour or two after labour is over. Hæmorrhage occurring after the first day of the puerperium is called *secondary post-partum hæmorrhage*, or *puerperal hæmorrhage*; the latter term is preferable, as it is desirable not to confuse it with the form of hæmorrhage under consideration. Many lives have been lost from this complication of labour; bleeding may supervene so suddenly and profusely that, unless it can be checked, death will ensue within half an hour to an hour. A disaster such as this may follow a rapid and apparently an easy labour; it is therefore of the first importance that its causation, and the principles which underlie its prophylaxis and immediate treatment, should be clearly understood. In proportion as these principles are generally acted upon, post-partum hæmorrhage becomes less frequent and less formidable.

Causation.—There are only three *local* conditions which can be regarded as immediate causes of post-partum hæmorrhage—viz. *uterine exhaustion* or *inertia*, *incomplete retraction*, and *lacerations* of some part of the genital tract (cervix, vagina, vulva); in the two former the bleeding comes from the torn utero-placental vessels (placental site); in the latter from torn vessels at the seat of injury. Uterine exhaustion at this period implies failure, more or less complete, of both contraction and retraction—*i.e.* it is identical with the condition previously described as secondary inertia (p. 322). Cases of real gravity which imperil or destroy life are generally due to this cause; it is obvious that exhaustion of the uterus, when the placenta has been separated, will allow of hæmorrhage of the most profuse kind, for muscular action is the only effectual means of closing the mouths of the torn sinuses. The circumstances which may lead directly or indirectly to post-partum uterine inertia must therefore be carefully borne in mind; they can be conveniently grouped into *predisposing* and *immediate* causes. As they have all been previously considered in detail, little more than an enumeration of them is here required.

Predisposing Causes of Post-partum Inertia.—Multiparity, especially when associated with rapid child-bearing, is the most important; such cases, in other words, as are liable to secondary inertia during labour. Post-partum hæmorrhage from inertia in a primipara is rare. *Debility*, especially as met with among the poor from insufficient feeding and insanitary occupations or surroundings, is also of importance. *Over-distension* of the uterus (twins, hydramnios), *ante-partum hæmorrhage*, *secondary inertia* during the second stage, *protracted* or *precipitate labour*, and the prolonged administration of *chloroform* must all be regarded as conditions which increase the risks of the occurrence of post-partum inertia.

Immediate Causes of Post-partum Inertia.—Artificial delivery of the child during a period of *secondary inertia* involves serious risk of post-partum hæmorrhage, as has been explained in another place (p. 323). It may be repeated here that absolute cessation of the pains during labour forms a contra-indication to delivery. One of the causes most frequently met with is *mismanagement of the third stage* of labour. The importance of continuous manipulation of the uterus during and after this stage has been pointed out; if this precaution is neglected the uterus may fill with blood and even become distended (relaxed) without any external bleeding attracting attention; serious loss of blood may then occur, which will in turn induce an extreme degree of inertia. The uterus very generally requires stimulation at this period of labour. Sometimes post-partum inertia appears to be reflexly induced by a *full bladder*, and it may also without doubt be brought on by *nervous shock*. It is probable also that in some cases inertia is complicated by *deficient coagulability* of the blood preventing the formation of thrombi in the mouths of the sinuses, but, with the exception of the rare disease hæmophilia, we know nothing of the conditions which cause it. Since efficient retraction of the uterine muscle suffices of itself for the immediate arrest of the hæmorrhage, deficient coagulability of the blood is of secondary importance.

Incomplete Retraction.—Mechanical obstacles to proper retraction will occur when portions or the whole of the placenta or membranes have been retained in the uterus, and sometimes when there is a fibroid tumour in its wall. It does not necessarily imply want of activity of the uterine muscle.

Lacerations.—Those which affect the cervix and run up into the vaginal roof, so as to open the broad ligament to a greater or less extent, are the most formidable; arteries of considerable size, and large venous plexuses, may be laid open, giving rise to free bleeding. Tears of the vulva and lower vaginal walls seldom cause severe hæmorrhage; but it must be remembered that the large artery to the clitoris may be lacerated by a tear of the anterior part of the vulva, or the artery to the bulb by a deep lateral tear of the perineal body.

Diagnosis.—Post-partum hæmorrhage is usually visible; it may, however, be either partly or entirely concealed from distension of the uterus with blood-clot, or from the formation of a large broad-ligament hæmatoma. The condition of the uterus is an important indication of the cause of the bleeding; for if exhausted it is soft and flabby, with indistinct outlines; but if the bleeding comes from a laceration the uterus will probably be found to be hard and well retracted. Uterine inertia and lacerations may of course exist in company; it is necessary to remember this when hæmorrhage continues after proper retraction of the uterus has been secured. Careful digital examination will be required to detect deep lacerations involving the vaginal roof.

A. Treatment of Hæmorrhage from Inertia.—In normal labour the separation and expulsion of the placenta are neither accompanied nor followed by serious bleeding, because the mouths of the torn maternal vessels are immediately closed by continuous retraction of the uterine muscle, especially of the reticulated layer; after the lapse of a few hours firm thrombi are formed in the mouths of the torn vessels, which plug them securely. Retraction is by far the more important of the two; for thrombosis alone must be powerless to prevent hæmorrhage from large arteries until time has been allowed for the consolidation of the thrombi. The treatment of post-partum hæmorrhage from inertia must therefore be directed in the main towards restoring the suspended activity of the uterine muscle, efforts to promote thrombosis being relegated to a strictly secondary position. When stimulation of the uterus is unsuccessful, bleeding can be temporarily arrested by compression of the organ, while time is allowed for the recovery of the functions of the muscle. In severe cases there is no time to lose, and it is of the utmost importance that the treatment adopted should be prompt and efficient. The following methods of stimulating the uterus should be employed consecutively, and in the order stated, until success is attained.

(1) *Manipulation of the Uterus per Abdomen.*—At the first sign of unusual hæmorrhage, this method can be instantly applied; it is therefore mentioned first. The uterus should be seized with both hands, rubbed and squeezed, firmly and continuously, until it is felt to respond by becoming harder as it is manipulated. If the placenta has not been delivered it should at once be expressed, or if necessary removed by the fingers. When fairly contracted the uterus should be firmly squeezed in the hand and pressed downwards and backwards in order to express all blood-clot from it (fig. 136). Firm retraction will not be obtained until the uterine cavity has been completely emptied. Even when the bleeding has apparently been controlled in this manner, gentle massage must be kept up for half an hour or more, as relaxation may recur. Difficulty in applying this method may be met with when the hæmorrhage is concealed and the uterus distended and flabby. Such cases are better dealt with in the first instance by *clearing out the uterus.*

(2) *Administration of Ergot.*—A full dose of ergot may be given as soon as abdominal compression is begun. Its effect is produced most rapidly when given by deep intramuscular injection, and the buttock is a convenient spot for the purpose. Ten or twenty minims of the injectio ergotinæ hypodermica may be given; or the same dose of the aseptic (sterilised) ergot supplied by druggists in sealed glass capsules. If given by the mouth, the dose should be from one to two drachms of the extractum ergotæ liquidum. While very useful in cases of moderate severity, ergot appears to have no effect upon a completely exhausted uterus, and if the condition of the patient is very serious, time should not at this stage be occupied in administering it.

(3) *Hot Douches.*—While abdominal compression is being practised the nurse in attendance can prepare a hot douche (temperature 118° F.) of boiled water, or some mild antiseptic such as lysol (ʒj. to a quart). This is a valuable supplement to abdominal manipulation, for it powerfully stimulates the retraction of the uterine muscle. Given through a long tube passed up to the fundus of the uterus, it is of course more effectual than when employed vaginally. The medical attendant cannot leave the uterus when there is serious bleeding in order to prepare the douche, and unless a reliable nurse is present it had better be omitted at this stage. It is of the greatest service in increasing and maintaining retraction when the hæmorrhage has been to a great extent controlled by other means, but it is of little use to give it until the uterus has been fairly well emptied of blood-clot by compression or by the method next to be described.

(4) *Clearing out the Uterus.*—When abdominal compression fails to produce an adequate response, when there is concealed bleeding, or when the placenta has not been delivered and cannot be expressed, the uterine cavity should be promptly cleared out with the fingers. The most careful sterilisation of the hands must be practised before this is done. The whole hand can be introduced into the vagina immediately after labour without causing the patient much pain, and two or three fingers can then be passed into the uterus, and, working in connection with the other hand upon the fundus, will readily clear out retained portions of the after-birth or blood-clot and at the same time powerfully excite the

uterus to contract. Great care must be taken not to overlook small portions of adherent placenta. When a good response has been obtained and the uterus is felt to close down upon the fingers, a hot *intra-uterine* douche can be administered, the nozzle being passed before the hand is withdrawn.

All but the most serious cases of hæmorrhage from inertia can be successfully dealt with by these means. In the worst cases, which are fortunately very rare, these methods may fail, and recourse must then be had to the following modes of treatment:

(5) *Bi-manual Compression of the Uterus.*—This can immediately be carried out if evacuation of the uterine cavity fails to induce proper retraction. The whole hand, which has been already passed into the vagina, is closed so that the fist lies beneath the uterus; the other hand is laid palm downwards upon the abdominal wall over the fundus, and the body of the uterus firmly squeezed between the two hands. In this way the placental site is directly compressed, and bleeding from the utero-placental vessels controlled. It may be necessary to keep up this form of compression for a prolonged period while other measures are adopted for restoring the patient, and so enabling the uterus to recover its activity. This method has entirely superseded the old-time plan of directly compressing the abdominal aorta against the lumbar vertebræ; pressure applied directly to the site of bleeding is, of course, much more effectual than compression of such a large vessel as the abdominal aorta.

(6) *Plugging the Uterine Cavity with Iodoform Gauze.*—This may be done as an alternative to the last-named, or after bi-manual compression has been applied without complete success. Long strips of gauze, two or three inches wide, and tied together, can be stuffed into the uterus, beginning at the fundus and tightly packing the whole organ down to the cervix. In plugging the uterus the cervix should be seized with a strong pair of volsella forceps, with which it can be easily pulled down to the vulva; the gauze is then introduced with a long probe or pair of forceps. A very large quantity of gauze is required to fill the uterus. Domestic substitutes such as strips of boiled linen, being less absorbent, are of less value. The uterine plug acts mainly as a powerful excitant of uterine contractions; if it fails to stimulate the uterus it

probably does little good, for, owing to the distensibility of the elastic uterine walls, it is practically impossible to pack the organ so tightly as to control hæmorrhage by direct pressure. When retraction has been excited, a certain amount of direct pressure will then be exerted by it. Bi-manual compression is more useful than plugging because it can be instantly applied, requires no assistance and no appliances, and is more reliable as a means of hæmostasis.

(7) *Methods of promoting thrombosis* in the uterine vessels were formerly practised, but have now been almost entirely abandoned. The injection of solutions of iron into the uterus, though useful at the moment in arresting bleeding, was frequently followed by sepsis. In adrenalin we now possess a harmless hæmostatic, which can be obtained in sterile solution, and it would be sound treatment to swab the uterine walls thoroughly with this solution (1–1,000 to 1–2,000), or previously to soak in it the gauze used for packing, in any case in which complete control of the bleeding could not be obtained by other methods. Also its use would be clearly indicated in subjects of hæmophilia.

Hæmorrhage from *incomplete retraction* should be treated by the immediate removal of what is retained in the uterus, and then by the same measures as in the case of inertia.

B. **Treatment of Hæmorrhage from Lacerations.**—Lacerations of the vulva and lower parts of the vaginal walls causing hæmorrhage should be immediately closed by suture, bleeding points being first ligatured. Deep lacerations of the cervix and vaginal roof are not easily closed by sutures; it may be very difficult to reach the highest point of the tear, and if the broad ligament has been opened bleeding points may be quite inaccessible. Accordingly many cases have been recorded where bleeding has continued after the laceration has been apparently sewn up. Two alternative methods to suture may be adopted: (1) bi-manual compression, (2) plugging with iodoform gauze. *Bi-manual compression* is described and practised by Fritsch. He places the closed fist against the perineum and presses the pelvic floor deeply into the pelvic outlet; owing to the relaxed and insensitive condition of the parts this can easily be done. The uterus at the same time is pressed firmly downwards from the abdomen with the other hand, and thus the parts in the vicinity of the vaginal roof can be effectually compressed between the two hands, and the bleeding controlled. For *plugging* a laceration in the vaginal roof a speculum and a good light are required.

C. **Restorative Treatment.**—Although the first indication in treatment is to arrest the bleeding, the general condition of the patient, in severe cases, also requires prompt attention, lest death from syncope should occur after the hæmorrhage has been controlled. The best method of immediately counteracting the effects of severe loss of blood is the administration of normal saline solution in large quantities. Even when the patient's condition is not urgent, the injection of a pint or a pint and a-half of this solution into the rectum is the best means of counteracting the shock and relieving the thirst which always follow severe hæmorrhage. But if, during or after the bleeding, the patient is blanched, cold, unconscious, or if her pulse is over 140, transfusion of one to two pints of normal saline solution into the median basilic vein should be practised. There is no necessity to describe this simple surgical procedure or the apparatus required for its performance. If the necessary apparatus is not at hand, a useful alternative is to inject the solution under strict antiseptic precautions into the subcutaneous tissue with a cannula, a piece of rubber tubing, and a funnel. A useful form of this simple apparatus is shown in fig. 212; it occupies very little space in the obstetric bag, and can be taken to every case as a routine item of the armamentarium. The most suitable positions for the subcutaneous injection are (1) under the mammary glands, (2) under the skin of the posterior axillary wall, (3) under the skin of the abdominal walls. Salt should be dissolved in water in the proportion of about one teaspoonful to a pint, and the solution boiled for ten minutes and then cooled. If there is no time for preparation, the salt may be simply dissolved in warm previously boiled water. These methods are, of course, greatly to be preferred to the procedure described as *auto-transfusion*—*i.e.* bandaging and elevating the legs and arms in order to keep the greatest possible amount of blood circulating in the head and trunk. This may be practised in addition if the condition of the patient is urgent.

The administration of cardiac stimulants by the mouth and by hypodermic injection is also of great importance, and the obstetric bag should always contain remedies of this kind. Strychnine sulphate, in doses of $\frac{1}{30}$ to $\frac{1}{60}$ of a grain, is the most useful remedy for hypodermic medication. Ether or brandy may also be administered in the same manner in doses of 20 to 30 minims. Elevating the foot of the bed for ten to twelve inches may assist the enfeebled circulation to some extent. The value of small doses of morphia in controlling restlessness after severe hæmorrhage should not be overlooked; a dose of $\frac{1}{8}$ to $\frac{1}{6}$ of a grain, alone or in combination with atropine, will relieve pain or restlessness, and often induce a little sleep, which will be of great benefit to the patient. Complete rest, free administration of fluid nourishment and stimulants, and the greatest possible amount of fresh air are the chief desiderata during the early days of convalescence. As involution of the uterus is delayed after severe hæmorrhage, the lying-in period must be prolonged, and as the resistances to infection are lowered by hæmorrhage, there are increased puerperal risks of sepsis.

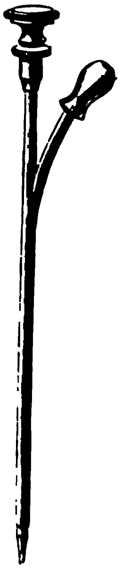

FIG. 212.—TROCAR AND CANNULA FOR SUBCUTANEOUS SALINE INFUSION.

Labour complicated by Eclampsia

The pathology of eclampsia having been already discussed (p. 80), only clinical points will be here considered.

Occurrence.—When the albuminuria of pregnancy is appropriately treated it seldom terminates in eclampsia. This disease most frequently occurs in women who up to the time of its onset have been in apparently good health; but had examination of the urine been made, it is highly probable that albumen would have been found before the onset of the disease. A certain number of cases of eclampsia have been recorded in which no albumen was found in the urine. This [illegible] however, very rare; Olshausen met with it only once in

168 cases. About 98 per cent. of cases occur after the sixth month (twenty-fourth week), but it has been observed as early as four and a-half months. The convulsions commence most frequently before, or almost simultaneously with, the onset of labour; more rarely after labour has been for some hours in progress; and least commonly after labour is over. Pinard estimates the first-named at 54 per cent., the second at 30 per cent., the third at 16 per cent. of all cases. Labour complicated by eclampsia is nearly always premature. If there is a history of eclampsia in a previous labour, the presence of chronic nephritis must be suspected.

Clinical Features.—Although eclampsia may attack a pregnant woman who has apparently been in good health up to the moment of its onset, a series of well-marked symptoms usually precedes it occurrence. The symptoms associated with the albuminuria of pregnancy may have been present for some time; but in addition certain other symptoms often occur which constitute what is called the *pre-eclamptic state.* They are (1) severe headache, usually frontal, but sometimes occipital; (2) functional disturbances of vision, such as muscæ volitantes, diplopia, hemianopsia, and temporary amblyopia; (3) occasionally well-marked albuminuric retinitis, with considerable failure of vision; (4) puffiness of the eyelids and cheeks; (5) severe epigastric pain, with giddiness, nausea, or vomiting; (6) occasionally, attacks of *petit mal.* The condition of the urine seldom furnishes premonitory signs, but a sudden increase in the amount of albumen, a fall in the total output of urea, or a marked diminution in the total amount of the urinary secretion may occur, the last-named being of gravest import. A certain amount of clinical evidence has recently been adduced which appears to indicate that a definite rise in blood-pressure precedes the occurrence of fits. This point has, however, not been completely established.

The convulsions are epileptiform in character, and consist of a stage of tonic, followed by a stage of clonic, contractions. Each convulsion is ushered in by fibrillary twitchings in the muscles of the face, tongue, and limbs, often followed by conjugate deviation of the head and eyes—usually to the left side. Then comes a brief period of tonic contraction in which respiration ceases, and the trunk may pass into the condition of opisthotonos; this is accompanied by marked cyanosis, the face being livid, and the tongue protruded between the teeth. This stage usually lasts less than half a minute, and gives place to general clonic contractions which appear to affect all the voluntary muscles of the body. Slight respiratory movements now occur, and the cyanosis gradually passes off during the period of three to five minutes which this stage generally occupies. A varying amount of mental disturbance follows the fit: in some cases the patient appears to be merely sleepy or somewhat dazed for a few minutes; in some cases there is a brief period of coma; in others deep coma persists, the patient failing to regain consciousness before the onset of the next convulsion.

The convulsions are almost always multiple; they may occur every hour, or every half-hour; in more serious cases, with greater frequency than this. As many as a hundred fits may occur in a single case. During the eclamptic state the excretion of urine is greatly diminished, and may for some hours be suppressed; it frequently contains blood, and nearly always a large amount of albumen, becoming solid on boiling. In all cases of eclampsia the urine must be examined, the catheter being employed to obtain a specimen if necessary. When a considerable number of fits has occurred, the temperature usually rises to 101° to 102° F., and in some cases there is hyperpyrexia. Death may result from coma, from cerebral hæmorrhage, or from pulmonary œdema, but it rarely occurs during a convulsion.

Diagnosis.—It is necessary to distinguish the following conditions from eclampsia: (1) epilepsy; (2) hysteria and hystero-epilepsy; (3) convulsions or coma due to cerebral disease, diabetes, or acute poisoning. *Uræmic convulsions* are difficult to distinguish from eclampsia, but the general line of treatment to be pursued is much the same in all cases. In cases of suspected chronic nephritis large doses of morphia should not be administered. Cases of *epilepsy* can usually be recognised by the history obtained from the patient or her friends; when a history cannot be obtained, the condition of the urine furnishes the most reliable means of distinction; but it must be recollected that in the rare cases of eclampsia without albuminuria the absence of albumen from the urine will be misleading. In general clinical features, the *status epilepticus* closely resembles a severe case of eclamptic coma with elevation of temperature. Cases of *hysterical* fits, and cases of *coma* due to causes other than renal, must be differentiated by attention to the special features of these disorders into which we cannot enter here.

Prognosis.—The outlook in eclampsia is always very serious both for mother and child. The *maternal mortality* appears to vary considerably; older statistics estimate it at from 40 to 50 per cent.; in more recent observations it has been placed at 20 to 25 per cent. The mortality is decidedly higher in multiparæ than in primiparæ. When the fits precede labour, the prognosis is always graver, though not necessarily hopeless. Mild cases of eclampsia occurring before labour can sometimes be treated successfully, and the advent of normal labour may be awaited. It is, however, better to induce labour in such cases, in order to avoid the risks of a recurrence of the convulsions. The greater the number of fits, the more serious is the prognosis; in cases where more than twenty attacks occur the mortality is upwards of 50 per cent. When the fits are prolonged, when the temperature steadily rises, and when there is early or continuous coma the prognosis is very grave indeed. Jaundice is rarely met with, but when accompanied by scanty and bloody urine a fatal termination must be expected. Yet the great majority of cases of eclampsia recover when labour terminates speedily and the number of convulsions is not great, nor their character severe. In severe cases which recover prolonged mental disturbance may continue, or insanity may supervene in the puerperium.

The *fœtal mortality* is largely influenced by the period of gestation; in cases at the seventh month or earlier it amounts to nearly 100 per cent., becoming less as term is approached. The occurrence of convulsions in the new-born child, and of post-mortem hepatic lesions similar to those of the mother, has been already mentioned (p. 82). This heavy mortality is to be attributed to prematurity and debility, to intra-uterine intoxication, to placental disease, and to injuries received during operative interference.

Treatment.—Two distinct subjects have to be considered: (I.) The treatment of the convulsions. (II.) The management of the labour.

I. Treatment of the Convulsions.—The importance of prophylactic treatment has been more than once referred to. When eclampsia has actually set in, the first point to be considered is the *immediate treatment* of the *seizures*. During the fit nothing can be done except to prevent the patient from injuring herself. She should be turned upon her side to allow the salivary secretions, produced in excess during the convulsions, to escape from the mouth, and to prevent their finding their way into the air-passages while the patient is unconscious and her reflexes are suspended. To save the tongue from being bitten the best plan is to fold a handkerchief in several thicknesses, pass it between the teeth over the tongue, and hold it in position until the clonic contractions have ceased. The clothing should be arranged so as not to impede respiration.

The main object of treatment will be to *control* as far as possible the *recurrence* of the *convulsions*. Many different methods of securing this object have been recommended and practised; some of these are now obsolete, and those which are of importance can be conveniently arranged, according to the indication which they fulfil, in two groups.

The first indication is to control the convulsions by the administration of *anæsthetic* or *sedative drugs which directly influence the central nervous system*; the second is to control the convulsions by *promoting the elimination* through all possible channels *of the toxic products* to which they are due.

(1) *Anæsthetic* or *sedative drugs* tend to prevent the periodic explosions of central nerve energy which cause the convulsions. Of all the drugs of this class which we possess, chloroform is the most useful in eclampsia, for the reasons that its effect is produced with great rapidity, that it can be administered by inhalation even when the patient is unable to swallow, and that as it is rapidly eliminated it can be administered continuously and in large quantity. During the convulsions chloroform cannot be given by inhalation with any effect, because the respiratory movements are then practically suspended. It should be given continuously during the intervals to an extent sufficient to produce sleep and partial anæsthesia, which can be maintained if necessary for several hours without injury to the patient. The frequency and severity of the fits can apparently be greatly reduced in

this way. Chloroform is indicated only when the fits are severe and recur frequently; it would of course be unwise to employ it in the manner just described in mild cases where few convulsions occur, or in cases of continuous coma.

Next to chloroform, the most generally useful drug is *chloral hydrate*; it should be given in full doses, by the mouth when the patient can swallow, by the rectum when she cannot. It is useful to give *bromide of potassium* in combination with it. Thirty grains of chloral and fifteen grains of bromide may be given by the mouth every hour, until four doses have been administered; when given by the rectum the dose should be doubled, and the lower bowel must be cleared out before its administration is begun. If the amount stated produces no beneficial effect, it is useless to persist. When coma is continuous these drugs should not be administered, at any rate in large doses; but there is no objection to their exhibition in mild cases.

Morphia may be used instead of chloral and bromide; as it can be given by hypodermic injection its effect is more rapidly and conveniently produced. Half a grain may be given at first, followed by a quarter of a grain after an interval of two hours or more; this may be repeated if required, as much as two grains being administered in twenty-four hours. Its action is chiefly exerted upon the central nervous system, but it is possible that its influence in retarding metabolism may be useful in controlling convulsions. Morphia should not be given to a comatose patient, or when chronic nephritis is suspected.

It will be seen from the foregoing remarks that sedatives and anæsthetics are chiefly useful when the patient recovers consciousness completely between the seizures. In all circumstances they can only be regarded as accessories in treatment, for their effect is but palliative, and leaves the cause of the convulsions practically uninfluenced.

(2) A considerable number of different methods of *promoting* the *elimination* of the *toxic products* circulating in the blood may be adopted, and the most important must be briefly referred to.

(*a*) *Venesection.*—The treatment of the case can be commenced by withdrawing ten to fifteen ounces of blood from the median basilic vein. This old method, it has been suggested, may be re-introduced, in the light of modern views, as a means of rapidly reducing the total amount of toxins in the body, and of immediately lowering blood-pressure. Nevertheless it cannot be recommended for general use, because nothing should be done which will enfeeble a patient suffering from such an exhausting condition as repeated general convulsions. It will, however, be useful in robust patients, but should not be adopted when well-marked anæmia and anasarca are present.

(*b*) *Subcutaneous injection of normal saline solution.*—This comparatively new method consists in injecting with a cannula and funnel one to two pints of an alkaline sterile saline solution (ʒj. sodium chloride and ʒss. of sodium acetate to Oj. of water) into the subcutaneous cellular tissue under the mamma, or under the skin of the abdominal walls, thighs, or axillæ. The injection can be repeated at intervals of an hour or two, and very large amounts of fluid can in this way be rapidly introduced into the circulation. Its immediate effects are to lower the toxicity of the blood by dilution and slightly to increase its alkalinity, and to cause diaphoresis; later on, after an interval of upwards of twenty-four hours, a powerful diuretic effect is produced. It can be administered in cases of every degree of severity and does not interfere with other methods of treatment, nor can any ill effects follow if surgical cleanliness is observed. It is therefore suitable for routine use, and there is no doubt that it forms a valuable addition to the methods of treating eclampsia.

(*c*) *Purgation* and *Diaphoresis* were formerly regarded as the most important methods of promoting elimination. *Purgation* can usually be rapidly produced by giving one to two minims of croton oil by the mouth, but this remedy is too severe for debilitated patients. Further, if the patient is comatose, and the act of swallowing purely reflex, the drug may pass into the air-passages. Milder aperients may be given when the patient can swallow, or a solution of sulphate of magnesia may be injected into the rectum in doses of ℥ss. to ℥j. of the salt. As an alternative to purgation it is useful to empty the colon by repeated high enemata, followed by irrigation with large quantities of boiled water or normal saline solution. *Diaphoresis* can be produced by hypodermic injection of nitrate of pilocarpine in doses of $\frac{1}{10}$ to $\frac{1}{3}$ of a grain; but this powerful drug also produces salivation and great depression of the circulation, and in feeble patients may cause fatal œdema of the lungs; it cannot therefore be recommended in eclampsia. Safer methods of causing sweating are the hot pack, the hot bath, or the vapour bath. These can be used under all circumstances except when delivery is imminent, and the hot pack can be applied with very simple materials which are available in the homes of all classes of patients. Profuse sweating, lasting for an hour or two, may be thus produced.

When the temperature rises to 105° F. or higher, some means of reducing it should be applied. The body may be rubbed with pieces of ice, or immersed in a tepid bath (70° to 80° F.), and kept there until the rectal temperature has fallen two or three degrees. Profuse sweating follows, and the temperature continues to fall after removal from the bath.

A recent addition to remedies for eclampsia is *thyroid extract.* This substance has been given by Nicholson and others both as a prophylactic and during the eclamptic state. Nicholson believes eclampsia to be due to a deficient production of iodothyrin during pregnancy, and therefore regards thyroid extract as the physiological antidote. Without accepting this theory, it may be admitted that thyroid is useful in eclampsia in lowering blood-pressure and stimulating the kidneys; indeed its diuretic action is definite and important. It may be given by the mouth in doses of thirty to forty grains, repeated when required, until symptoms of thyroid intoxication appear.

II. Management of Labour in Eclampsia.—Opinion upon this subject among writers on eclampsia is sharply divided into two schools. On the one hand it is claimed that the convulsions are not set up by labour, for they often occur without it, and Herman has shown that in about 57 per cent. of cases they continue after labour is over; therefore the management of labour is unimportant in comparison with the treatment of the convulsions, and upon this principle the conduct of each case should be regulated. On the other hand, it is claimed that the fundamental cause of the convulsions is pregnancy, and accordingly the production of the toxic bodies to which the convulsions are in all probability due can only be arrested by terminating the pregnancy, or, in other which by stimulating the uterus. Therefore the ultimate cure of eclampsia is the delivery of the patient. These propositions, though apparently contradictory, are not so in reality. Although the termination of pregnancy arrests the production of toxins, time is required for the elimination from the body of those already formed. Accordingly the case cannot be regarded as cured when the patient is delivered. An amount of toxic material sufficient to cause death may still remain in the body. From this it follows that immediate relief can best be obtained by the methods just described for controlling the convulsions, and upon these methods reliance must chiefly be placed in treatment. The indication to terminate pregnancy, though equally clear, is for the time less urgent, and should be relegated to the secondary place. In cases of great severity it appears inherently probable that serious operative methods of rapid delivery may be absolutely injurious in the enfeebled state of the patient, while it is certain that they offer no certain prospect of immediate relief.

The following suggestions, based upon these principles, may be made as regards the conduct of labour:

(1) *In eclampsia before labour* the treatment should be at first medical; if the fits continue, labour must be induced by one of the rapid methods described on page 484.

(2) *During the first stage* the labour should be left to take its natural course, and in many cases will progress rapidly; if the case is serious and progress is slow, an attempt may be made to dilate with the Champetier bag and deliver by forceps, version, or extraction (breech). When profound coma supervenes either before or early in labour, delivery by *accouchement forcé* or vaginal Cæsarean section may be practised.

(3) *During the second stage* labour may at any time be immediately terminated.

PART V

THE PUERPERIUM

The Normal Puerperium

The puerperium is the period succeeding labour, during which certain processes take place, the effect of which is to restore the genital organs approximately to the condition which obtained before pregnancy. The features characteristic of nulliparity are never completely regained, for certain of the changes occurring in pregnancy, and the injuries received in labour, induce alterations which are permanent, although they may vary greatly in degree in different cases. The duration of the puerperal period may be stated as from six to eight weeks, but it is frequently longer than this. We do not possess any absolute clinical indication of the completion of the puerperal changes, but, as we shall presently see, the size of the uterus is the best guide.

Consideration of the normal puerperium comprises the following subjects:

(I.) The general physiology of the puerperium.

(II.) The involution of the genital organs.

(III.) The management of the puerperium, including the process of lactation.

I. **The General Physiology of the Puerperium.**—At the close of a normal labour the *general condition* of the patient is merely that of physical fatigue. The pulse is full and moderately slow—70 to 80 beats per minute; the temperature is usually sub-normal. Not infrequently a slight shivering, marked by muscular tremor and chattering of the teeth occurs, and may last from ten to fifteen minutes; it is unaccompanied by elevation of temperature or pulse-rate, and is of no importance, although the patient's friends may be alarmed by it. After a prolonged labour the patient may show signs of well-marked exhaustion, with a temperature of 100° F. or higher; and when severe hæmorrhage has occurred there will, of course, be shock and pallor, with a rapid pulse and a lowered temperature.

During the first twenty-four hours the temperature very commonly rises one or two degrees, even after a normal labour, and 100° to 101° F. may in this way be recorded without any unfavourable accompaniments. This is especially common in primiparæ. The rise of temperature is to be regarded as due to the *reaction* from the severe muscular fatigue induced by labour; it is never prolonged, and disappears entirely by the second day (fig. 213). After the first twenty-four hours the temperature shows a diurnal variation of about a-half to one degree, and in normal cases it often does not rise above 99·4° F. In many cases, however, which otherwise run a normal course, the evening temperature for the first few days may reach 99·8° or 100° F. Instability of the body-temperature is one of the characteristics of the puerperium; consequently variations occur from causes too

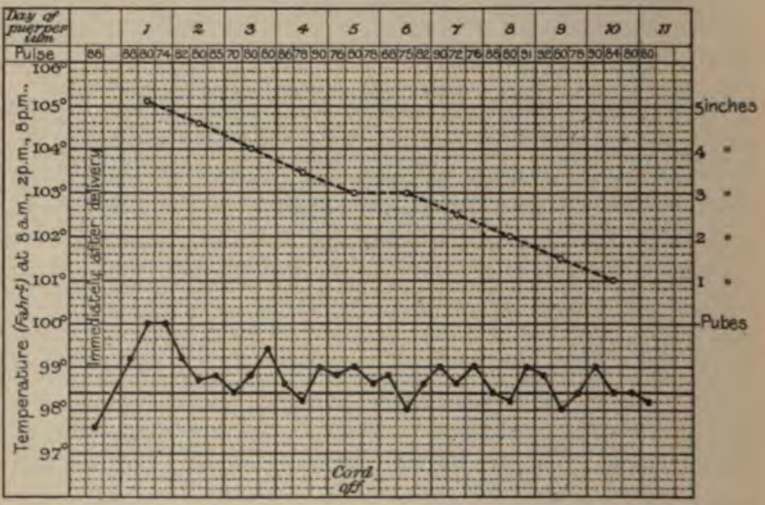

FIG. 213.—CHART OF A NORMAL PUERPERIUM SHOWING REACTIONARY RISE OF TEMPERATURE ON THE FIRST DAY (QUEEN CHARLOTTE'S HOSPITAL).

NOTE.—The interrupted line indicates the height of the fundus above the upper border of the symphysis pubis.

trivial to produce any effect in health. The temperature should be taken at least three times daily, convenient hours being 8 A.M., 2 P.M., 8 P.M.; if taken only morning and evening, an evanescent rise may escape notice. Temporary elevation of the temperature from 100° to 102° F. may occur during the first puerperal week from slight transient causes, such as errors in diet, copræmia, excitement or other nervous disturbance, or mammary discomfort at the commencement of lactation (fig. 214). Pyrexia from these causes lasts only a few hours, and does not in any way disturb the

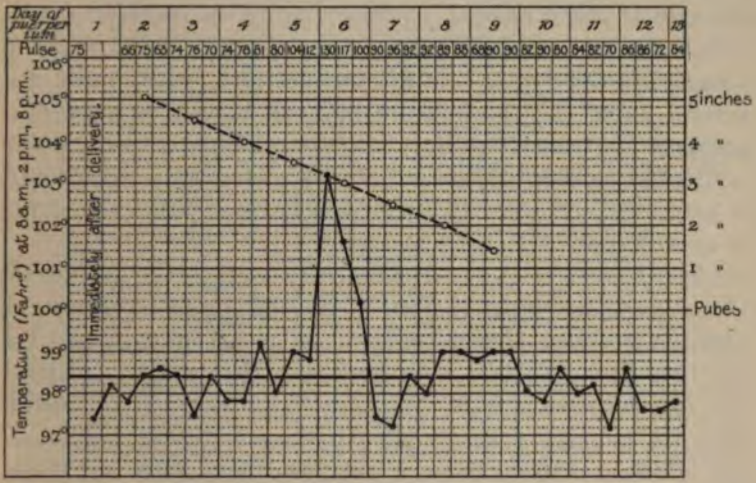

FIG. 214.—THE EVANESCENT RISE OF TEMPERATURE ON THE SIXTH DAY WAS DUE TO NERVOUS EXCITEMENT (QUEEN CHARLOTTE'S HOSPITAL).

general course of the puerperium. The significance of a rise of temperature in the puerperium is accordingly often obscure at first. Fever lasting for twenty-four hours or more is a certain indication of 'morbidity,' but evanescent rises of temperature are not necessarily to be regarded as definite evidences of abnormal developments. Various standards of 'morbidity' are in use in other countries, but in this country it has been generally agreed, upon the suggestion of a committee of the British Medical Association, to regard as 'morbid' all cases in which the temperature reaches 100° F., or over, on two occasions between the second and eighth days. This period will not include the *reactionary* rise just referred to. 'Fever' during the puerperium, as thus defined, is due in the great majority of instances to some degree—it may be slight, it may be severe—of septic infection. There are but few exceptions to the general rule that an aseptic puerperium is also afebrile ; it is, however, obvious that febrile affections, quite independent of the puerperium, may attack a lying-in woman, although no septic infection has occurred.

The *pulse-rate* is usually slow (60 to 70) for the first twenty-four to forty-eight hours, and if a reactionary rise of temperature occurs, the pulse-rate does not rise to a height proportionate to the temperature (fig. 213). After the third day the rate is about normal, varying slightly in correspondence with the temperature. In patients anæmic and debilitated from hæmorrhage the pulse-rate will remain abnormally rapid for several days. In the absence of such causes, a pulse-rate continuously over 90 is disquieting (fig. 223). A rising pulse with a falling temperature indicates hæmorrhage ; when fever is accompanied by a disproportionately rapid pulse, the cause is usually sepsis.

The Excretions.—Great variations occur in the amount of *urine* excreted during the early days of the puerperium ; it appears, however, that the amount is, as a rule, increased for the first two days, and then gradually falls until it reaches the normal level. Sugar is normally present in the urine after the mammary glands have become active ; it is lactose, not glucose, and is derived not from the liver but from the mammary glands. Peptones are present in small amount from the second to the tenth day, and observers are agreed in attributing them to the involution changes going on in the uterine muscle. Traces of albumen and acetone are frequently found, and the percentages of urea, phosphates, and sulphates are reduced. The act of urination is at first somewhat painful, and temporary retention of urine may occur either from spasm of the sphincter or from paresis of the muscular walls of the bladder.

The *skin* acts freely, and for the first few days the *bowels* are usually constipated.

Blood.—The deficiency in red cells and hæmoglobin, which is natural in pregnancy, is rapidly made up during the ten days following labour. The leucocytosis, also natural to pregnancy, rapidly disappears during the same period, the number of white corpuscles falling from about 21,000 per cm. to 10,000 per cm. (Henderson). The diminution in the number of leucocytes appears to bear some relation to the amount of the lochial discharge, a free discharge being accompanied by a more marked fall than a scanty discharge. A rapid rise in the number of leucocytes indicates the onset of some septic or inflammatory condition.

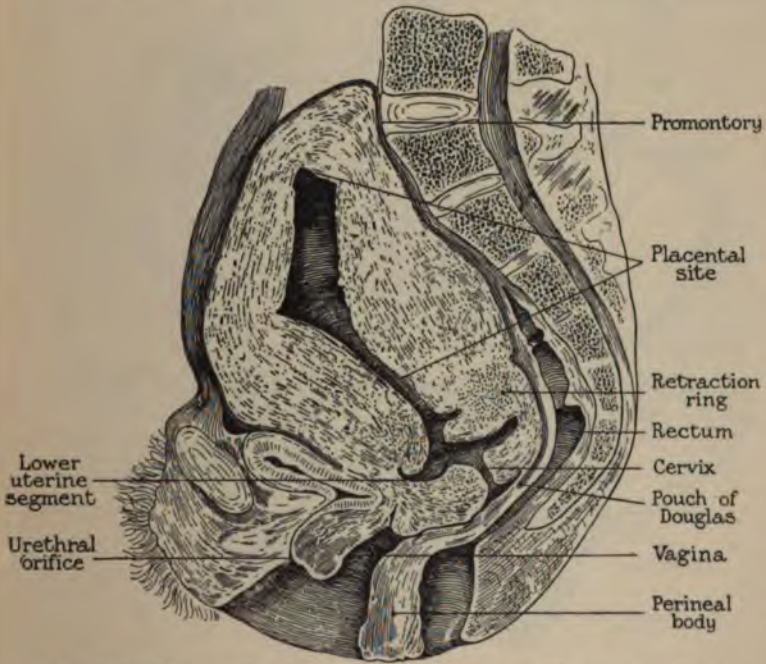

FIG. 215.—FROZEN SECTION OF THE PELVIS OF A WOMAN WHO DIED IMMEDIATELY AFTER DELIVERY. (BARBOUR.)

The *digestive functions* are, as a rule, depressed during the first two or three days, there is little or no appetite, and in consequence only fluid and easily digestible food can be taken.

Body-weight.—There is a slight progressive loss of weight during the first ten days, which is more marked in non-nursing than in nursing women.

II. The Process of Involution.—The *uterus* diminishes rapidly in size for the first ten days, and then more slowly, the whole process requiring six to eight weeks for its completion. According to Whitridge Williams, the uterus loses

50 per cent. of its weight during the first week of the puerperium. The diminution in size can be followed by abdominal examination, and forms a very important clinical index of the course and progress of puerperal involution generally. The condition of the uterus immediately after delivery is shown in the frozen section seen in fig. 215. It fills the pelvic cavity, and at its highest point rises slightly above the level of the sacral promontory; the two sections differentiated from one another during labour—viz. the body and the lower segment—are still distinct, and the cervix is once more distinguishable from the latter. In section the wall varies in thickness, measuring from 1½ to 2 inches (4–5 cm.) where it is thickest, to less than ⅓ inch in the lower segment, and the uterine cavity is almost obliterated by apposition of the anterior and posterior walls. Its total length is 7¾ inches (20 cm.); the length of its cavity is 6¼ inches (15·5 cm.). Clinically the uterus immediately after delivery

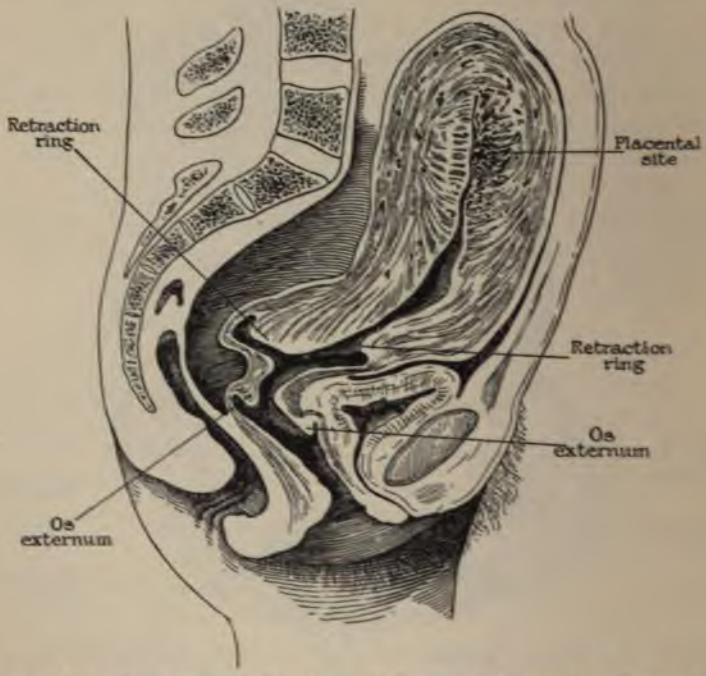

FIG. 216.—THE GENITAL CANAL OF A RECENTLY DELIVERED WOMAN (SEMI-DIAGRAMMATIC). (BUMM.)

forms a large, firm, pyriform swelling in the lower abdomen rising up to the level of the umbilicus (fig. 215), freely movable, and undergoing slow variations in consistence. Accurate study of the rate at which the uterus diminishes in size can be made only upon the cadaver, and Webster has collated the following table from observations of this kind:

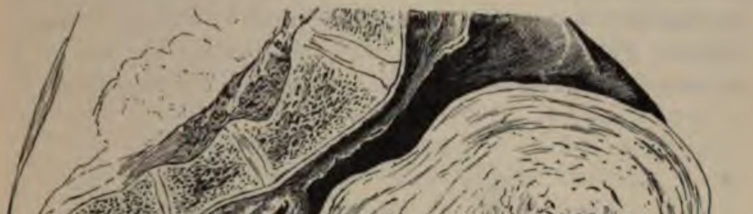

FIG. 217.—FROZEN SECTION OF THE PELVIS OF A WOMAN WHO DIED OF CEREBRAL HÆMORRHAGE THREE DAYS AFTER DELIVERY. (VARNIER.)

Date	Whole Uterus	Uterine cavity
Immediately after delivery .	7⅓ in. long	6¼ in. long
2nd day	7⅛ " "	6¼ " "
3rd "	6⅝ " "	5½ " "
6th "	5⅛ " "	4½ " "
15th "	3¾ " "	3⅜ " "

From this it will be seen that during the first week the uterus diminishes much more rapidly than during the second; that the total length diminishes more rapidly than the length of the cavity owing to the rapid reduction in the thickness and bulk of the walls; and that on the fifteenth day it is still very considerably larger than the normal organ (cavity 2½ inches—6 cm.). Fig. 217 shows that on the third day the uterus is not large enough to fill the pelvic cavity, and the lower uterine segment is no longer distinguishable. Fig. 218 shows further reduction in size on the fifth day; the walls of the cervix are much thinner, and the internal os has closed.

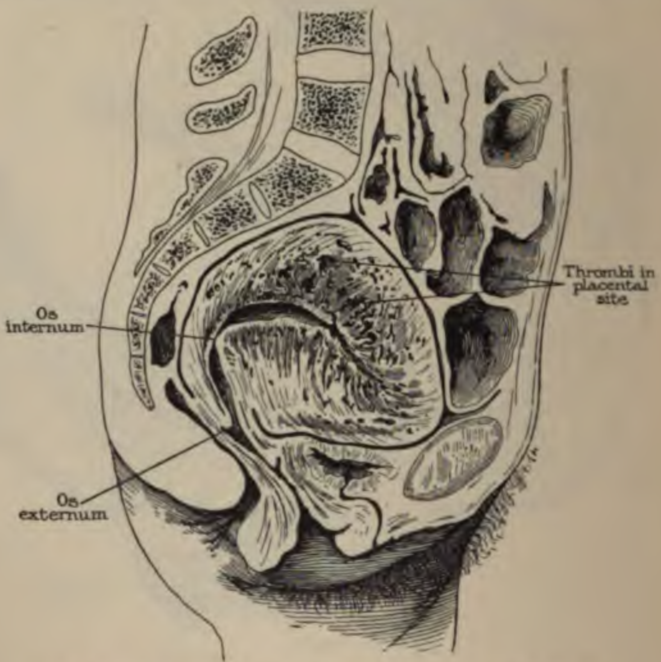

FIG. 218.—FROZEN SECTION OF THE PELVIS OF A WOMAN WHO DIED FIVE DAYS AFTER DELIVERY. (BUMM.)

The rate of involution varies considerably in different persons, even when the conditions appear normal. The measurements given above must therefore be regarded as approximate, not exact.

In making clinical observations attention is chiefly directed to the height of the fundus above the symphysis pubis. The results of such observations necessarily differ from post-mortem measurements of frozen sections. But it must be recollected that the position of the uterus is largely influenced by the condition of the bladder, and to some extent by that of the rectum. When the bladder is full the whole uterus is elevated, and usually displaced to one or other side, more commonly the right; the hypogastric region being occupied by a soft elastic swelling, dull on percussion, and readily recognisable as the bladder. Consequently, if daily measurements are made, they should always be made immediately after the bladder and the bowels have been evacuated, so as to ensure uniformity. From careful measurements made by Griffith and Stevens at Queen Charlotte's Hospital, it appears that the average height of the fundus on the first day is 5¼ inches; by the sixth day it has fallen on an average to 3¼ inches, and by the twelfth day to 1¾ inch above the pubes. After the fourteenth day the fundus, as a rule, sinks below the level of the pubes—*i.e.* into the pelvic cavity; but not infrequently this does not occur until the end of the third week. The rate of involution, estimated in this way, is about the same in primiparæ and multiparæ, but in the latter the uterus is rather larger throughout. Roughly speaking, it may therefore be said that at the end of the first week the fundus should be halfway between the pubes and the umbilicus, and at the end of the second week just palpable above the level of the pubes.

The importance of systematically observing the involution of the uterus, as a guide to the normal progress of the puerperium, cannot be over-estimated. When recorded upon the temperature-chart in the manner indicated in figs. 213 and 214, it supplies, along with the temperature-curve, almost all the information which is required as to the general condition of the patient. The progress of involution will be delayed by retention of clot or membrane in the uterus, by sapræmia, by inability to suckle, and also in women who have had a considerable number of previous pregnancies.

Changes in the Uterine Muscle.—Very careful measurements of the fibres of the uterine muscle during the puerperium have been made by Sänger; he found that in length they diminish rapidly and at a fairly uniform rate, until at the fifth week they are actually shorter than in the non-pregnant organ; in breadth they increase during the first few hours by retraction, and then steadily diminish until at the fifth week they are only a trifle broader than before pregnancy. Fatty degeneration has also been described in the muscle fibres by numerous observers. Helme has described in the rabbit's uterus a process of degeneration which he believes to be due to peptonisation of the protoplasm of the muscle cells; and associated with it he found multinucleated plasmodia (phagocytes) among the degenerating fibres, engaged, as he believed, in absorbing them. Destruction of muscle by phagocytosis has never been demonstrated in the human uterus, and it is generally held that fatty degeneration and peptonisation are the processes chiefly concerned. In this connection it will be recollected that peptones are present in the urine of puerperal women.

The Uterine Mucosa.—A considerable portion of the cavernous layer of the decidua remains attached to the uterine wall; at the placental site it forms a continuous covering, elsewhere bare patches of the muscular wall may be seen. The membrane is furrowed and folded by the retraction of the subjacent muscle, and soon becomes covered with a layer of fibrin. In seven to eight weeks the mucous membrane is entirely re-formed by proliferation of the remaining epithelial and connective-tissue elements. When the puerperal uterus of the first week is laid open, the placental site may be readily distinguished, as its surface is slightly elevated and irregular, the irregularities being chiefly caused by the extensive thrombosis which has occurred in the sub-placental sinuses (fig. 220). Outside the placental site the wall is smooth and uniform.

The Lochial Discharge.—This is the discharge which escapes from the genital canal during the first two to three weeks of the puerperium. For the first twenty-four hours it consists of blood, mostly fluid, but frequently containing small clots; it then becomes thinner, though still of the colour of recent blood. About the third or fourth day it becomes brownish; by the end of the first week it is yellowish or greenish; and then gradually loses all colour, being white and turbid until its final disappearance. Besides red blood cells and fibrin, it contains leucocytes, decidual débris, vaginal epithelium, mucus corpuscles, and in the later stages pus cells. Peptones and cholesterin crystals have also been found in it. According to Giles, the amount of the lochia is greater than normal after hæmorrhage during labour and is habitually greater in women of dark complexion than in blondes, and in those who lose freely during menstruation than in those whose menstrual loss is scanty. It is a common observation that when the uterine cavity has been douched after labour the amount of lochial discharge is always less than normal.

Throughout a normal afebrile puerperium, in the *uterus* the lochia are alkaline in reaction, sterile, and usually have a faint sickly odour; in the *vagina* they become acid, and after the first few days usually contain numerous non-pathogenic bacteria. In a few instances bacteriologists have found such pathogenic bacteria as the gonococcus and staphylococci in both the vaginal and uterine lochia in a clinically normal afebrile puerperium. Under morbid conditions the lochia may be suddenly suppressed, or may become fetid from infection, or may be altered by fresh hæmorrhage. When involution is delayed, they may persist longer than usual, although not abnormal in characters. The source of the lochial discharge is mainly the uterine cavity, but cervical, vaginal, and vulval lacerations also contribute to it to some extent.

After-pains.—In multiparæ the normal puerperium is usually accompanied for the first one or two days by painful contractions of the uterus, which are known as after-pains. They are probably excited by the presence of some foreign body, such as a blood-clot or a piece of membrane or placenta. From imperfect retraction blood-clot may form in the uterine cavity even after it has been completely emptied at the end of the third stage; this is much more likely to occur with a multipara than with a primipara, for retraction is usually adequate in primiparæ. But when the uterus is not empty, after-pains may be met with in a primipara just as in a multipara. After-pains should be treated by stimulating the uterus to expel the foreign body. This may be done by giving ʒj. of liquid extract of ergot every four hours, by massaging the uterus per abdomen, and by a hot vaginal douche (115°–118° F.) of boiled water, or a mild antiseptic such as lysol, ʒj. to Oij. Sedatives are not indicated.

III. **Management of the Puerperium.**—There are three objects to be kept in view in the management of the lying-in woman: (1) to maintain asepsis in the genital canal; (2) to enforce a sufficient period of complete rest; (3) to regulate the function of lactation.

(1) *Asepsis.*—If the antiseptic precautions observed during labour have been successful, the genital canal will be sterile at the commencement of the puerperium; and the principal care of doctor and nurse is to prevent infection from reaching it. The greatest possible care must accordingly be taken of the vulva. The lochial discharge should be received upon sterilised pads of absorbent wool or gauze, or these substances impregnated with an antiseptic such as corrosive sublimate; the pads should be removed and burned as soon as they become soiled. During the first three or four days the vulva should be frequently swabbed with a solution of lysol (℥j. to Oj.). After urination or defæcation this solution should be again used. It is essential that the nurse's hands and all the appliances used, such as catheters and vaginal nozzles, should be as carefully sterilised during the puerperium as during labour.

Vaginal douching is unnecessary when the puerperium runs a normal course. The aim of management should be to preserve the genital tract from contamination, and so maintain its naturally sterile condition, rather than to endeavour to destroy organisms which may have gained access to it. No amount of vaginal douching can compensate, for instance, for careless treatment of the vulva. Vaginal douching, in addition to being unnecessary, may become positively dangerous, when carried out carelessly or by untrained persons, by introducing into the vagina organisms which would not otherwise obtain access to it. Routine vaginal douching has accordingly been almost universally abandoned. Yet there is little doubt that the mechanical clearing of the vagina by the douche is comforting to the patient, and prevents stagnation of the lochia in the vaginal fornices—a condition very apt to occur while the patient continuously maintains the recumbent position. These advantages are, however, not of sufficient importance to outweigh the attendant risks. Decomposition of the lochia, indicated by fœtor, is the most frequent indication for the douche in an afebrile puerperium, and a solution of 1 in 4,000 of biniodide or perchloride of mercury is the best solution to employ under these circumstances.

Hot antiseptic or sterile douching may also be required for the control of puerperal hæmorrhage or to promote the expulsion of blood-clot or membrane retained in the uterus.

Other antiseptics which may be employed for vaginal douching are lysol ʒj. to Oj., izal or cyllin ʒj. to Oj., or carbolic acid 1 in 60. A solution of iodine (ʒj. of tinct. iodi to Oj. of water) may also be used, and is frequently employed as an intra-uterine douche, on account of its non-poisonous nature. When douching the *uterus* in the early puerperium the same solutions may be employed in one-half the strength used for the vagina. Although these solutions are useful for douching, in sterilising the skin mercurial solutions are much more efficient than any others. It must be remembered that by the indiscriminate use of mercurial douches acute mercurial poisoning may be set up, and some such cases have proved fatal. The symptoms of mercurial poisoning from absorption are the same as those produced when the poison is taken by the mouth—viz. vomiting, diarrhœa, salivation, acute gingivitis; sometimes in fatal cases patches of sloughing in the mucous membrane of the colon have been found.

When a perineal laceration has been sutured the wound should be kept freely dusted with powdered boric acid, and strips of bi-cyanide gauze laid in contact with it on each side of the sutures.

A well-ventilated room free from risk of contamination from faulty drain-pipes, and clean fresh bed-linen and bed-garments, are valuable aids to the maintenance of asepsis; yet in the homes of the poor, where these desiderata cannot be obtained, the local precautions indicated will succeed, in all but a few cases, in preventing infection.

(2) *Rest.*—Rest in bed, but not necessarily in the horizontal position, should be maintained until the uterus has sunk below the symphysis pubis and the lochial discharge has become colourless. When ordinary avocations are resumed with the uterus as large as it is on the tenth day of the puerperium, it is clear that there must be some liability to prolapse, retroversion, and sub-involution. The poor habitually neglect this precaution, but there is little doubt that they suffer in consequence. After the first forty-eight hours the patient may be propped up with pillows or a bed-rest, and this position is of

advantage in promoting the escape of the lochia. Light and nourishing food, both solid and fluid, may be given freely during the first two days; an aperient should be administered on the evening of the second day, and after this ordinary food may be taken. The condition of the bladder must be carefully watched during the first two days; if retention occurs resort should not be had to the catheter until all means of procuring spontaneous evacuation have been tried. The strictest antiseptic precautions are required for this simple procedure. Occasionally the bladder is imperfectly evacuated by the natural efforts and becomes gradually over-distended, causing great discomfort. This condition will readily be recognised by careful abdominal examination. Emotion and excitement may produce alarming rises of temperature in lying-in women; therefore, in private practice, patients should be practically isolated for the first few days. Sleep almost always comes naturally to a lying-in woman, but hypnotic drugs should be given without hesitation if sleep is absent or insufficient, for sleeplessness may be a prelude to serious mental complications.

(3) *The Process of Lactation.*—By lactation is meant the establishment of functional activity in the mammary glands. Certain signs of activity, which have been already described, are present in the breasts during the greater part of the period of pregnancy. For forty-eight hours after delivery no further change takes place; during the third day the breasts undergo rapid enlargement, becoming tense, nodular, and often very tender to the touch, the skin being tense and glistening. They are then full of thick yellow secretion which can readily be expressed, or may escape spontaneously from the nipple. During the first week the secretion is known as *colostrum*. Considerable local pain and general discomfort usually attend the 'coming of the milk,' and a rise of one or two degrees of temperature may occur for a few hours. Suckling speedily relieves the over-distension of the glands, and in one or two days all symptoms of discomfort disappear, although active secretion will continue for many months. After suckling for two or three days the secretion becomes thinner and less yellow. The mammary secretion is established somewhat sooner in a multipara than in a primipara, and the initial distension is less severe.

Colostrum possesses certain special features which are sometimes of forensic importance as evidence of recent delivery. Its naked-eye appearances have been indicated; under the microscope it is seen to contain, besides the polymorphous fat-globules characteristic of milk, certain special elements which have been named *colostrum corpuscles.* These are leucocytes containing large droplets of fat. Epithelial cells in a more or less advanced state of fatty degeneration, which have been detached from the walls of the glandular acini, are also seen (fig. 219). They disappear after the first few days of suckling. The anatomy of the function of lactation is fully described in text-books of physiology, and need not be referred to here. The immediate cause of the sudden onset of mammary activity on the third day of the puerperium is quite unknown, although much speculation upon it has been indulged in. It may conceivably be due (1) to nervous impulses received from the uterus or ovaries; (2) to the presence of some bio-chemical substance in the blood, the effect of which is to stimulate the mammary glands.

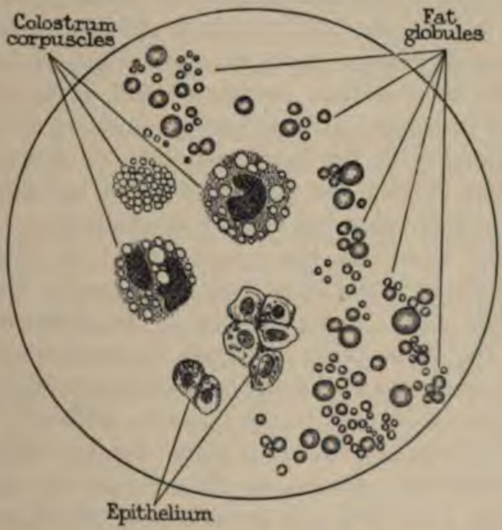

FIG. 219.—THE ELEMENTS OF HUMAN MILK (COLOSTRUM). (BUMM.)

The composition of human milk will be referred to in connection with Infant Feeding (p. 449).

The child cannot be fed regularly from the breast until the secretion becomes fully established about the third day. During the first two days it may be allowed to draw what it can from the breasts occasionally; probably more food will not be required than it can thus obtain, but if hunger is indicated by restlessness and crying, small quantities of diluted cow's milk may be given in addition (see Infant Feeding). It is necessary to prepare the nipple carefully for the process of suckling during the last few weeks of pregnancy, especially in the case of a primigravida. The skin of the nipples and areolæ should be cleansed once or twice daily, bathed with boric acid lotion 1-40, and finally swabbed or painted with alcohol—eau de Cologne being an agreeable form in which to use it. The skin is thus disinfected and hardened. If the nipples are depressed a breast-pump must be used to draw them out, and with the additional help of frequent gentle manipulation, exciting the reflex erection of the nipple by its muscles, the depression can usually be overcome.

After the third day the infant should be fed from the breast at regular intervals of two hours during the day and three or four hours during the night. In giving the breast, great care should be taken to adjust the mother's position so that the child can reach the nipple comfortably without having to turn or stretch its neck in the attempt. Difficulty in getting the child to take the breast is often due to neglect of this simple precaution. In ten to fifteen minutes enough will usually have been obtained to satisfy the child, and it will then fall asleep or cease to suck. After each feed the mouth should be cleansed with a piece of cotton wool dipped in boric lotion; this is required because a little milk accumulates in the cheeks, where it will ferment if allowed to remain and give rise to digestive disturbances or thrush. The nipples must also be cleansed with boric lotion and carefully dried every time the child has been fed. A piece of clean lint, or preferably a small pad of sterilised cotton, should be kept applied to the nipple, and the breasts lightly supported by a binder. In this way the nipples can be absolutely protected from infection, and the occurrence of mastitis prevented.

Cracked or Sore Nipples.—Primiparæ frequently suffer from the formation of fissures of the nipple at the commencement of the process of suckling. They may occur either at the apex or the base, and in the latter position are sometimes overlooked. They probably begin as slight abrasions caused by the gums of the child, or by the vigorous use of its buccinator muscles. If the secretion is scanty, or if the child is allowed to take the breast before any secretion can be obtained, unusually vigorous suction will be made, and abrasions may thus be formed upon the nipple. These abrasions, becoming infected, give rise to fissures. They render the process of suckling extremely painful, and may lead, if neglected, to the formation of a mammary abscess. If at all deep they bleed during suckling, and the blood, being swallowed along with the milk by the child, may later on be rejected so as to create the impression that the child is suffering from hæmatemesis.

Except in severe cases, cracked nipples can be successfully treated as follows: a glass nipple-shield must be used for suckling so as to protect the nipple from the child's mouth; in addition to the usual cleansing, the nipple should be painted with a mild antiseptic such as boroglyceride, glycerine and carbolic acid 1–20, or dilute sulphurous acid; finally it should be covered with wet boric lint. When the fissures are severe, suckling from the affected breast should be stopped for twenty-four hours, the nipple thoroughly disinfected, touched with nitrate of silver, covered with dry boric-acid powder, and the whole breast tightly bandaged to arrest the secretion. The unaffected breast will probably suffice for the child's needs for this period; if not, the bottle may be given as well (see p. 452). In intractable cases suckling may have to be given up altogether.

Puerperal Infection

Under the term 'puerperal infection' is included a series of febrile disorders of the lying-in period due to the active development of certain pathogenic bacteria, which enter the body through wounds of the genital tract; in the great majority of cases these organisms are introduced from without, but in a few instances they may have been lurking in the genital tract at the time of labour. It must be borne in mind that puerperal infection may occur after abortion as well as after labour.

All controversy as to the nature of 'puerperal fever,' 'child-bed fever,' or 'milk fever,' has long since been set at rest, and we now know it to be due to sepsis or wound-infection. To a Scotch physician, Dr. Robert Gordon, of Aberdeen, belongs the credit of first publicly declaring his belief that puerperal fever was infectious and could be carried from patient to patient by the doctor or the nurse (1795). About 1840 to 1843 Oliver Wendell Holmes in the United States, and Semmelweiss in Vienna, independently recognised that puerperal fever could also be set up by infection carried from the dead-house. To Semmelweiss has been now adjudged the chief credit of this important discovery; but his work was to a great extent neglected for thirty years, when the discoveries of Lister placed the matter upon a scientific basis by showing that bacteria were the agents by which surgical infection was produced and propagated. Doléris, working with Pasteur, first showed in 1880 that streptococci could be found in the uterus in cases of 'puerperal fever,' thus definitely bringing the disease into the class of 'wound-infections,' and demonstrating its close relation to suppurative processes. Experience has shown that infection from these sources is even more serious than infection from the dead-house.

The work of all these observers has resulted in the practical disappearance of puerperal infection from lying-in hospitals, and has undoubtedly been the means of saving the lives of innumerable lying-in women. In the time of Semmelweiss outbreaks of puerperal infection occurred from time to time in maternity hospitals, sometimes attended by the appalling mortality of 60 to 75 per cent.; and seldom did the mortality from puerperal fever in these institutions fall below 10 per cent. At the present time the mortality from puerperal fever in such hospitals is about 1 to 2 per 1,000, and epidemics are unknown. No more striking instance than this exists of the value of Lister's principles. But puerperal infection still occurs, although not in epidemic form, and the returns of the Registrar-General show that between 1893 and 1903 the number of deaths from this cause in England and Wales averaged nearly 2,000 per annum. Boxall has shown that during this period of ten years there has been no general improvement in the mortality from puerperal infection, although it must be assumed that the medical profession has now become thoroughly convinced of the importance of the routine application of antiseptic principles to obstetric work.

A. **Causation.**—There are three factors to be considered in the causation of puerperal infection: (I.) The bacteria. (II.) The channels of infection. (III.) The powers of resistance of the infected tissues.

I. **The Bacteria.**—Since puerperal infection gives rise to a whole group of disorders, it is not surprising to find a variety of different micro-organisms concerned in its causation. These may be conveniently divided into three groups: (a) *saprophytic organisms*; (b) *pyogenic organisms*; (c) *certain specific organisms.*

(a) *Saprophytic organisms* are bacteria which grow and multiply in dead tissues, causing the phenomena of putrefaction; they do not invade the body generally, and they tend to disappear spontaneously when the pabulum upon which they flourish is exhausted; the general effects which they produce are due to the absorption into the circulation of the noxious products of their growth and development—the *toxins*. These organisms are mostly bacilli, but their varieties are very numerous and do not require full mention. The following species have been found in cases of puerperal infection:

(1) Bacillus proteus vulgaris.
(2) Bacillus septicus.
(3) Bacillus aerogenes capsulatus.

They are the chief agents in the production of the clinical condition to be described later on as *sapræmia*.

(b) *Pyogenic Organisms.*—These are the common organisms which produce suppuration and sepsis; those which have been found in connection with puerperal infection are:

(1) Staphylococcus pyogenes aureus.
(2) Staphylococcus pyogenes albus.
(3) Streptococcus pyogenes.

These organisms, no matter what may be the part of the body first attacked by them, tend to spread by the lymphatics and blood-vessels so as to cause general septicæmia. They are the organisms which are most to be feared by the obstetrician, for their distribution in crowded centres of population is almost universal, in dust, in soiled clothing, and even in the atmosphere. The discharges from a case of puerperal fever usually contain these organisms in a state of virulence. Every focus of suppuration forms a centre of distribution from which they may be spread broadcast in countless numbers, and thus become the cause of fresh wound-infection. It is obvious that the presence of suppurating sores upon the hands or arms of the medical attendant or nurse, or even upon the body of the patient, must involve the most serious risk of infection by direct contact. And further, the transmission to a lying-in woman of organisms from other patients suffering from these conditions can only be avoided by the most scrupulous surgical cleanliness.

(c) *Specific Organisms.*—The following specific organisms have been found in cases of puerperal infection:

(1) Diplococcus gonorrhœæ.
(2) Bacillus coli communis.
(3) Bacillus diphtheriæ (Klebs-Löffler).
(4) Pneumococcus.
(5) Bacillus tetani.
(6) Bacillus typhosus.

The actual relation of these organisms to the causation of puerperal infection is a matter of some uncertainty. There is reason to believe that the two first named may in certain cases be the sole, or at any rate the principal, cause of infection. The three last named probably occur only in association with the pyogenic cocci, although this is denied by some authorities. The gonococcus produces as a rule only local pelvic inflammation; both the pneumococcus and the bacillus coli may produce virulent forms of peritonitis or general septicæmia. The Klebs-Löffler bacillus produces in the genital tract the same species of false membrane which characterises throat-infection by the same organism. Puerperal tetanus occurs, but is an extremely rare condition.

Mixed Infection.—It is exceptional to find that puerperal infection is due to a single species of organism; and further, in a large number of cases it cannot even be said that the organisms concerned belong to a single member of the three groups just described. Saprophytes may be found in company with pyogenic cocci, and the latter with certain of the specific organisms; or members of all three groups may be associated in a single case. This fact, as we shall see, exerts an important influence upon the clinical features and treatment of cases of puerperal infection. It is believed that the most virulent cases are those due to mixed infection. It also appears that the pyogenic cocci may sometimes assume a saprophytic *rôle*, remaining confined to the uterine cavity, and producing symptoms of sapræmia alone.

Autogenetic and Heterogenetic Infection.—In almost every case of puerperal infection, the organisms are introduced into the genital tract from without (*heterogenetic infection*) by surgically unclean fingers, instruments, diapers, or other matters applied to or introduced within the vulva. It must not be forgotten that the vulva itself, like all other areas of skin, may be septic, and that hands or instruments, after being carefully sterilised, may become re-infected in passing through it. The risk of hetero-infection will be greatly increased by the presence of local sores, such as fistula *in ano*, vulval furuncles &c., or of sores upon the hands of the medical attendant or nurse, or by contact with other sources of infection, or by insanitary personal or general surroundings. But of all modes of infection, the one most to be feared is the carriage of organisms from one case of puerperal infection to another. Puerperal infection by the bacillus coli is in all probability heterogenetic, not autogenetic—*i.e.* the organisms are derived from external sources, not from the intestinal tract of the patient. So far as we know, this bacillus only becomes virulent to its host in certain morbid conditions (injury or disease) of the bowel. But it occurs widely distributed in dust, especially road dust, and may therefore be introduced into the genital canal as the result of imperfect surgical cleanliness. Sewer gas was at one time regarded as a potent cause of puerperal infection; this was probably an error, for sewer gas contains, as a rule, no organisms, and the effects it produces upon the lying-in woman are those of sewer-gas poisoning, not wound-infection.

By *autogenetic infection* is meant infection of the genital tract by organisms existing in or near it before labour. The possibilities of auto-infection are, however, strictly limited, and this variety should never be diagnosed in a particular case without the clearest demonstration. It cannot be said that anything like satisfactory evidence of auto-infection has ever been furnished in the case of any organism except the gonococcus. Puerperal infection may, however, be caused by gonococci which, during pregnancy, have been lurking in some part of the vagina or cervix, or even in the decidua or the Fallopian tube. The possibility of this organism remaining latent for a considerable time, and then assuming well-marked activity on being transferred to a new location, is well known, and doubtless accounts for its occasionally causing serious results in lying-in women. In this way acute ascending gonorrhœal inflammation may arise, involving not only the uterine cavity, but also the ovaries, tubes, and peritoneum. Again, when such local conditions are present as carcinoma of the cervix, appendicitis, or a chronic pelvic abscess, acute infection of the genital tract from these sources may also occur spontaneously. But when puerperal sepsis accompanies acute specific fevers such as scarlatina, typhoid, or diphtheria, it is much more probable that the infection has been carried from without than that it has reached the genital canal through the circulation, although it cannot be denied that this is theoretically possible. Unless there is pre-existing or concurrent infective disease in or near the genital tract, autogenetic infection probably does not occur.

II. **The Channels of Infection.**—(a) *Lochia.*—It has been already stated that, while in the normal puerperium the uterine cavity is usually sterile, the vagina contains a variety of organisms, non-pathogenic in character. The normal defence against infection offered by the healthy vaginal secretion with its specific bacillus is lost, and the alkaline lochia, rich in albuminous material, provide an excellent culture-medium for any organisms which may obtain access to them. The condition of the genital tract is, accordingly, such as to offer special facilities for bacterial infection.

(b) *Dead Tissue.*—A certain amount of dead tissue is always present in the puerperal uterus—viz. fibrin, blood-clot, and possibly a thin layer of decidua which undergoes necrosis and is cast off. This may be supplemented by fragments of placental tissue or chorionic membrane which remain attached to the uterine wall. Thus the conditions requisite for the growth of saprophytic organisms always exist in greater or less degree in the uterus. In difficult or instrumental labour, areas of sloughing from prolonged or excessive compression may occur. But it must be remembered that dead tissue will not decompose unless bacteria are allowed to obtain access to it; so that the presence of dead tissue *in the uterus* will not cause puerperal infection if the aseptic management of the lying-in period is successful.

(c) *Wounds.*—After every normal labour the continuity of the surface of the genital tract is broken by separation of the placenta, and by the more or less considerable lacerations which usually occur in the cervix or near the vulva; the latter are more severe and of more frequent occurrence in primiparæ than in multiparæ. Through these wounds toxins may be absorbed into the circulation, or pyogenic organisms, if present, may invade the tissues of the body generally. In the case of wounds of the cervix and vaginal roof organisms will find in the lymphatic channels a ready way of access to the cellular tissue of the broad ligament, and may thus give rise to pelvic cellulitis. It is probable, from what is known of the pathological anatomy of puerperal sepsis, that generalised infection usually occurs by extension from an infected uterus, and not by absorption from wounds of the cervix or vagina. Bacteriological evidence has, however, been adduced by Foulerton and Bonney which appears to indicate that mild cases of puerperal fever may be due to infection through lacerations of the lower part of the genital tract, the uterus remaining uninfected and its contents sterile.

III. **The Powers of Resistance.**—The effects produced by bacterial infection depend partly upon the number and degree of virulence of the organisms, and partly upon the resistance offered by the tissues to their development. The general resistances are reduced by anything which exhausts or debilitates the patient, such as previous ill health, prolonged or difficult labour, hæmorrhage during or after labour, albuminuria, pre-existing pelvic inflammation, &c. Under such conditions the normal means of defence against bacterial invasion are inhibited or impeded, and no effective opposition can then be offered by the tissues to the attack of the organisms. The conditions just named are accordingly often spoken of as *predisposing causes* of infection.

B. **Pathological Anatomy of Puerperal Infection.**—Cases of extreme virulence, which rapidly reach a fatal termination in from two to three days, are sometimes met with, in which practically no morbid changes can be found in the genital

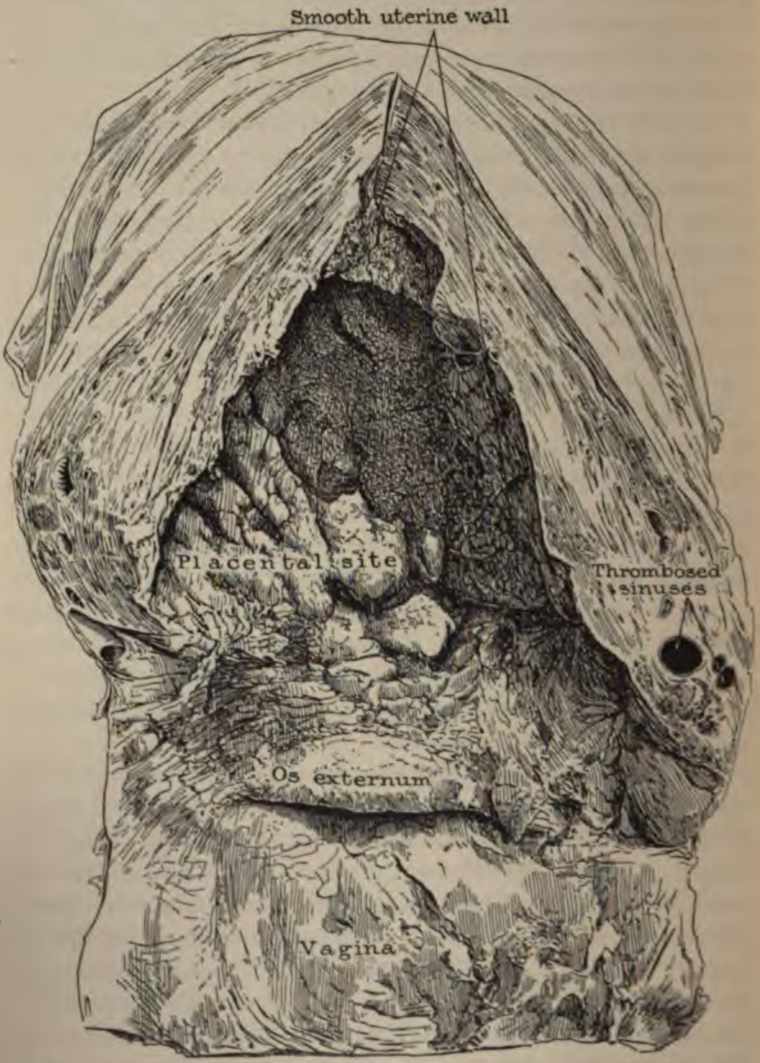

FIG. 220.—UTERUS FROM A CASE OF PLACENTA PRÆVIA AND PUERPERAL SEPTICÆMIA; STREPTOCOCCIC INFECTION; DEATH ON FOURTH DAY.
It will be noticed that the thrombosed placental sinuses are in the lower uterine segment.

tract. These cases are usually due to streptococcic infection, the organisms directly entering the blood and lymph vessels, and producing practically no reaction at the points of entry. Death is due to an overwhelmingly rapid formation of toxins within the circulation. In the great majority of cases of puerperal infection, however, well-marked alterations are found in the genital tract, but they differ greatly in their nature and distribution.

(1) *The Uterus.*—The general condition of the wall of the uterine cavity is variable. In pure streptococcic infection it is believed to be usually smooth and uniform, with little evidence of superficial necrosis. Thus in fig. 220 the greater part of the wall is smooth, but the placental site presents the usual elevated and irregular appearance (see p. 398). In mixed infection, on the other hand, it is shaggy and irregular from the presence of necrotic tissue.

The condition of the uterine wall has been carefully studied by Bumm. He has described inflammatory changes to which he has applied the name of *puerperal endometritis*, and has distinguished two varieties of this condition.

The first he calls *putrid puerperal endometritis*; it is characterised by necrosis of the superficial layers of the uterine wall, involving both the decidua and the subjacent muscle. To the naked eye this area of necrosis appears as a greyish or greenish discoloured layer, varying in thickness from a-quarter to half an inch. There is always a fœtid odour, sometimes accompanied by the production of bubbles of gas. This variety is due, according to Bumm, to infection by the colon bacillus or by saprophytic organisms. On microscopic examination of the uterine wall, a well-marked zone of leucocytic infiltration is found beneath the necrotic layer; this zone appears to form a barrier to the advance of the infecting organisms, for none are found either in it or in the tissues lying beneath it (fig. 221). Accordingly, with this variety of puerperal endometritis, symptoms of general infection are absent, for the dissemination of the organisms is prevented.

The second he calls *septic puerperal endometritis*. In this variety the uterine wall may suppurate, or a false membrane, greyish in colour, may form upon it; the latter is sometimes, though erroneously, named *diphtheritic endometritis*. There is no fœtor, and no production of gas. It is caused by the group of pyogenic cocci, of which the streptococcus is the most formidable. On microscopic examination it is found that the zone of leucocytic invasion, although present, is less extensive than in the first-named variety, and numerous organisms will be found to have invaded it—*i.e.* the barrier to dissemination of the organisms is feeble. In some cases the leucocytic zone is not continuous, presenting gaps here and there, through which the organisms can be seen to have made their way freely into the lymphatic spaces and blood-vessels of the subjacent muscle. In this way the frequency with which streptococcic uterine infection is accompanied by symptoms of general septicæmia can be anatomically explained. Occasionally, when the leucocytic zone is complete, streptococcic endometritis may produce only symptoms of localised uterine infection (sapræmia).

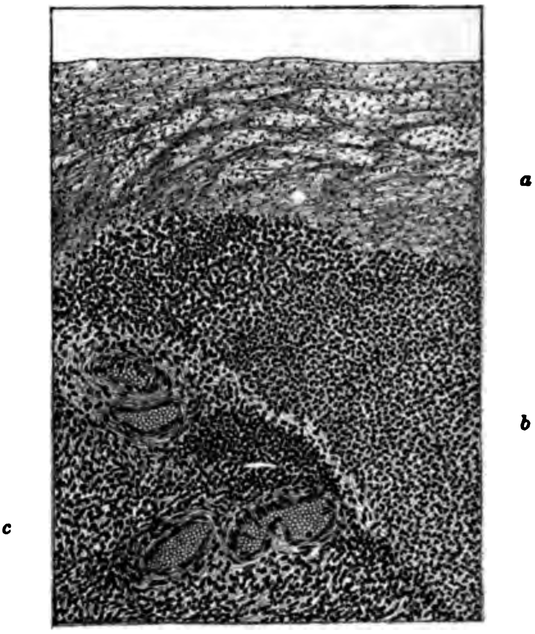

Fig. 221.—Puerperal Endometritis, showing marked Development of Leucocytic Zone. (Whitridge Williams.)

a. Fibrin layer. *b*. Leucocytic zone. *c*. Muscular wall with vessels.

In cases of mixed infection atypical appearances will be presented in the uterus. Adherent fragments of placenta or chorion may be found in either variety of puerperal endometritis.

The *muscular wall* of the uterus also is usually more or less inflamed (*metritis*) in both forms of puerperal endometritis. In rare instances of the septic variety, small interstitial abscesses may form. In very rare instances sloughing of more or less extensive areas of the muscular wall occurs—the so-called *metritis desiccans.* The venous channels in the general uterine wall are frequently found thrombosed and inflamed (*phlebitis*), and small collections of pus may sometimes be found in the thrombi. The general muscular tissue is said to be unusually soft and friable, and specially liable to perforation by such instruments as the curette.

The *serous coat* may escape altogether, or, in cases of great severity, patches, or a complete coating, of lymph may form upon it; in such cases the whole of the pelvic peritoneum, along with the tubes and ovaries, is generally inflamed (*perimetritis, pelvic peritonitis*). Infection of the peritoneal coat may be brought about by extension from the infected uterine cavity through the lymphatics, or through the advance of the infection by direct continuity from the uterine cavity to the mucous membrane of the Fallopian tubes, and through the abdominal ostia to the pelvic peritoneum.

(2) *The Cervix, Vagina, and Vulva.*—Lacerations of these parts when infected assume the appearance of ulcers with a dirty greyish base, produced by the formation of a false membrane consisting of the superficial necrosed tissues. In cases of severe perineal laceration which have become infected, superficial sloughing may occur over large areas of the injured tissues. Sometimes areas of sloughing are met with in the anterior vaginal wall. They are produced by prolonged and severe compression of the part between the fœtal head and the pubes, or between the forceps and the pubes; they are accordingly most often met with after a long and difficult second stage. If the patient survives, such sloughs separate during the first seven to ten days of the puerperium, and usually they produce a vesico-vaginal fistula, since the base of the bladder is necessarily involved in the compression.

(3) *Pelvic Cellular Tissue.*—Large inflammatory effusions (*cellulitis*) may be met with in one or both broad ligaments; or they may be so extensive as to involve the whole of the

pelvic cellular tissue, and spread to that of the iliac fossa and anterior abdominal wall. Such an effusion between the layers of the broad ligament is often called a *broad-ligament phlegmon*. The cellular tissue usually becomes infected by lymphatic extension from wounds of the cervix; cellulitis is probably always accompanied by a certain amount of uterine infection, but clinically the condition of the cellular tissue obscures that of the uterus, and the case is regarded mainly, if not entirely, as one of cellulitis. On post-mortem examination a cellulitic effusion forms a spongy mass, from which a clear or slightly turbid fluid exudes on section.

(4) *Peritoneum, Fallopian Tubes, and Ovaries.*—Peritonitis of variable extent is usually found in fatal cases of puerperal fever; usually it is limited to the pelvis. A certain amount of pelvic peritonitis often accompanies severe cases of uterine infection which recover, and probably all cases of cellulitis. Occasionally acute general peritonitis may be set up by an infected uterus. The Fallopian tubes may become infected by direct spread from the uterine cavity, and from them the infection spreads to the ovaries and the pelvic peritoneum. Pyosalpinx and ovarian abscess sometimes form, either rapidly or after a considerable interval. These, however, occur more frequently with gonorrhœal than with other forms of infection.

(5) *Pelvic Veins.*—Phlebitis may spread from the infected uterus into the broad ligaments; thence it may pass upwards through the iliac veins to the inferior vena cava, and the resulting long line of blood-clot may even reach the right ventricle. In other cases it passes downwards into the femoral vein, causing femoral thrombosis—a variety of the condition clinically known as *phlegmasia alba dolens* (see p. 434). By the distribution of organisms through the blood-stream *pyæmia* may occur.

C. Clinical Varieties of Puerperal Infection

The following clinical varieties of puerperal infection must be considered:

1. Uterine infection
    - Sapræmia.
    - Septicæmia.
2. General puerperal peritonitis.

3. Local pelvic inflammation :
    - Cellulitis.
    - Peritonitis.
    - Salpingo-oöphoritis.
    - Phlebitis.
4. Phlegmasia alba dolens.
5. Pyæmia.

1. Uterine Infection.—From what has been already said in connection with the pathological anatomy of puerperal infection, it will be evident that cases of infection of the uterus may be divided into two classes, corresponding to the two varieties—*putrid* and *septic*—of puerperal endometritis. Upon this basis two clinical types may be distinguished—*sapræmia*, corresponding to putrid endometritis, and *septicæmia*, corresponding to septic endometritis. *Sapræmia* may accordingly be described as a local uterine infection, due in the great majority of instances to saprophytic bacteria, but sometimes to pyogenic organisms ; there is no general dissemination of the organisms, which are limited to the uterine cavity, and the clinical symptoms are produced by the absorption from the uterus of the toxic products of bacterial action. *Septicæmia* may be described as a generalised infection due to pyogenic cocci, to the bacterium coli, or to various specific organisms, which enter the body through the genital tract, and become widely disseminated through the lymphatic or vascular system. But it will be remembered that mixed infection is not infrequent, and in such cases the local appearances in the uterus are atypical, and cannot be definitely placed in either class ; so also in such cases the clinical features are irregular, and may comprise many of those of both classes. While, therefore, it may be easy to make a diagnosis of *uterine infection*, it is not always possible to carry the diagnosis further than this, and the names 'sapræmia' and 'septicæmia' must accordingly be applied with some caution. In general terms it may be said that sapræmic infection is less severe than septicæmic infection ; the resulting illness accordingly is milder, runs a shorter course, and is less likely to be followed by complications.

The Onset of Uterine Infection.—It is at this stage that the differential diagnosis of the two varieties is difficult, and it will be best in the first place to consider the general symptoms of the onset of uterine infection without reference to its subdivisions.

The occurrence of evanescent rises of temperature in the puerperium from trivial causes has been already referred to; it will be remembered that in such cases the pyrexia is moderate in degree, is of brief duration, and yields easily to treatment. The possibility of the occurrence of intercurrent febrile affections, unconnected with the puerperal state, is also to be borne in mind. But the general rule, which must be rigidly applied, is that every case of 'fever' arising in the puerperium should be regarded as the result of infection unless some other cause for it can be definitely recognised.

The onset of *uterine infection* almost always occurs in the first puerperal week, and, except in rare instances, during the first four or five days. In mild cases the onset is characterised by rise of temperature to 101°–102° F., corresponding, or sometimes exaggerated, rapidity of the pulse, frontal headache, and more or less feeling of general illness or *malaise*. In severe cases the rise of temperature is ushered in or quickly followed by a rigor, the frequency of the pulse is exaggerated, the headache and malaise are more pronounced. Sapræmia is much more frequently associated with the mild type of onset than with the severe type; septicæmia may be equally well associated with either. Accordingly, while the mild type of onset is of no value in differential diagnosis, the severe type of onset indicates the probability of the case being one of septicæmia. A case which begins mildly may, however, run a severe and prolonged course.

The condition of the uterus must be carefully observed at the onset of uterine infection. In sapræmia involution is usually delayed or arrested; in addition, the uterine cavity may contain infected blood-clot or pieces of adherent placenta or membrane. Consequently the uterus is abnormally large for the puerperal date, and also, usually, tender to the touch. In septicæmia, on the other hand, involution is usually unaffected, the uterine cavity is empty, and the size of the uterus corresponds to the puerperal date. Many atypical cases will, however, be met with in which septicæmia is accompanied by sapræmia, and the uterus is too large for the puerperal date.

The lochia frequently become putrescent (offensive) in uterine infection. This is especially likely to occur if the uterine cavity contains blood-clot or placenta, and if saprophytic organisms obtain access to it. It is therefore commonly met with in sapræmia. But the presence of an offensive discharge must not be regarded as indicating anything further than infection; it does not even follow, necessarily, that the infection is in the uterus. The lochia may decompose at the vulva or in the vaginal canal, while the uterus remains unaffected, and no unfavourable symptoms whatever occur. On the other hand, septicæmia of the greatest severity may occur without any decomposition of the lochia whatever.

From what has now been said, it will be clear that it is often impracticable at the onset of a case of uterine infection to distinguish septicæmia and sapræmia from one another. Time is required in order that the general course of the illness and the effects of local treatment may be observed. But the treatment of uterine infection, to be efficacious, must be applied without delay, and consequently the onset of the disease must often be treated before a differential diagnosis of the two varieties is practicable. Treatment will be described later on; in the meantime the general features of simple sapræmia and simple septicæmia may be described, it being continually borne in mind that cases of mixed infection which resemble both, and differ from either, are frequently encountered.

Sapræmia.—The three outstanding clinical features of this condition are *pyrexia*, *decomposition of the lochia*, and *arrest of the process of involution* of the uterus.

The time of onset varies with the date of infection; if infection has occurred during labour, the symptoms usually appear on the second or third day; if infection has occurred subsequent to delivery, the symptoms will appear later. As a rule, the first symptom to appear is fever, which may be slight (100° to 102° F.) as in fig. 222, or severe (102° to 104° F.) as in fig. 223; a slight shivering may accompany the initial rise, but a pronounced rigor is unusual. The pulse-rate rises to an extent proportionate to the temperature. A certain amount of headache and general malaise are present, but the patient does not appear to be seriously ill. On examination of the abdomen, the uterus will usually be found to be unduly large for the puerperal date; it is tender to the touch, and softer than normal in consistence. The vulval pads should always be examined, when the fœtor of the lochia, if present, will be perceived, and shreds of tissue may be found upon them. In occasional instances no decomposition of the lochia can be detected; these cases are probably due to infection by pyogenic cocci, the growth of which has been limited to the uterine cavity. The amount of the lochia is often profuse, and sometimes an admixture of fresh hæmorrhage may be observed. A mild case of sapræmia when suitably treated can usually be cured in two or three days; more severe cases may last for a week or upwards before yielding to treatment (figs. 222 and 223). If untreated, the symptoms may increase in severity, and generalised infection —indicated by rigors and great rapidity of the pulse—or local pelvic lesions, will follow—*i.e.* the case has become one of septicæmia. Very slight cases of sapræmia are often met with in which the only abnormal indications are slight fever (100° to 101° F.) and a little enlargement without tenderness of the uterus. The patient may appear to be perfectly well; she complains of no headache, and the lochia

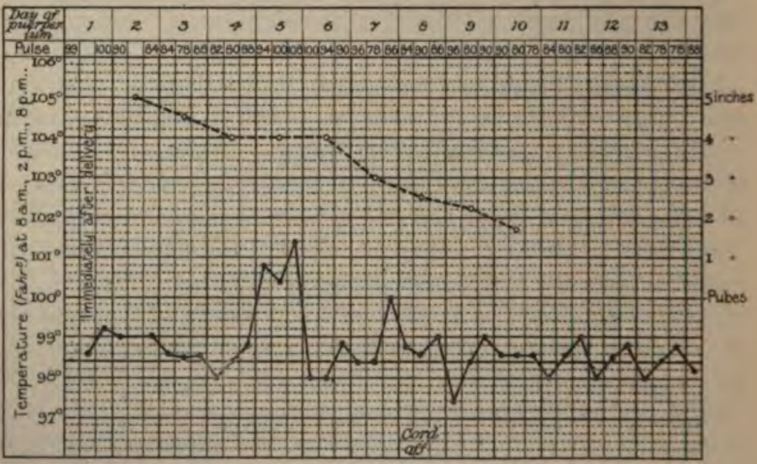

FIG. 222.—CHART OF A SLIGHT CASE OF SAPRÆMIA, SHOWING THE RISE OF TEMPERATURE AND ARREST OF INVOLUTION ON THE FOURTH, FIFTH, AND SIXTH DAYS.

are healthy. It is possible that these cases are really due to imperfect uterine drainage, resulting perhaps from the recumbent position, or from the presence of an uninfected clot in the uterus, preventing the escape of the lochia. The result is absorption from the uterus of waste products sufficient to slightly raise the temperature.

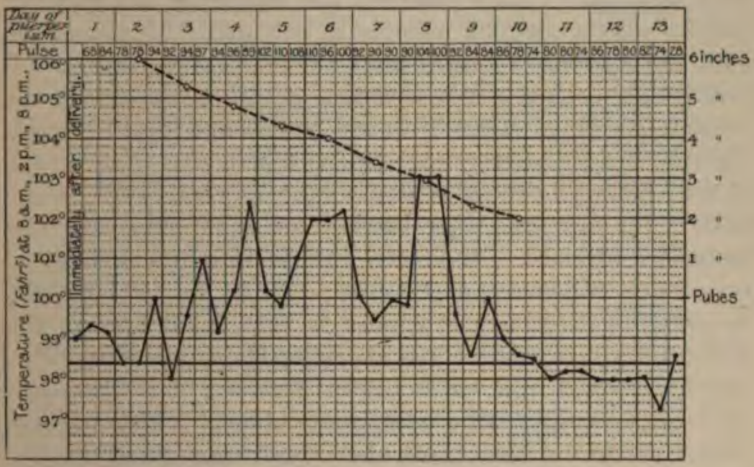

FIG. 223.—CHART OF A MORE SEVERE CASE OF SAPRÆMIA WHICH LASTED FROM THE SECOND TO THE EIGHTH DAY.

Septicæmia.—The symptoms of septicæmia bear a broad resemblance to those of sapræmia just described; generally speaking, however, they may be said to be of much greater severity, and much less amenable to local treatment. Septicæmia may be produced not only by various organisms, but by various classes of organisms; the clinical features accordingly show great variations. And further, since organisms exist in nature in various degrees of attenuation, the severity of the symptoms which they produce is variable. An exhaustive description of puerperal septicæmia is accordingly impossible except in a monograph; its main features can, however, be briefly presented. Our present knowledge does not enable us to recognise, from the clinical features, the organisms by which it is produced in a particular case.

Onset.—The onset is almost always acute, and seldom occurs later than the third day of the puerperium; it may, however, occur within twenty-four hours after labour, and as a rule it may be said that the earlier the onset the more acute will be the disease. While not invariable, an initial rigor occurs in the majority of cases; when regular temperature observations have been taken, a certain amount of pyrexia may be found to have preceded it. Headache and general malaise also sometimes precede it, but often the patient is quite unconscious of illness until the onset of shivering. A severe rigor begins with a sensation of cold so intense as to cause "chattering" of the teeth and general muscular tremors; the skin surface becomes cold to the touch and from spasm of the arrectores pili muscles assumes the appearance of "goose-flesh"; the face and lips become somewhat blue, and the features contracted. The rectal temperature in a moderately severe rigor will show a rise to 103°–105° F., but 106°–107° F. is sometimes reached; the pulse is very rapid, and, at the onset, difficult to count. The shivering stage may be momentary or may last from ten to fifteen minutes; it is succeeded by a congestive stage in which the sensation of cold gives place to one of burning heat; muscular tremor ceases, and the face becomes flushed; the skin feels hot and is at first dry, afterwards moist. Severe headache often accompanies this stage, during which the temperature rapidly falls several degrees; after a rigor of exceptional severity, it may fall to one or two degrees below the normal.

It will be most convenient to consider the general clinical features one by one.

Temperature.—The pyrexia always runs an irregular course, the general type of which is remittent. Repeated rigors may recur at irregular intervals in cases of acute infection; but no regular variations in the diurnal temperature occur, as, for instance, in typhoid fever; temperature charts, unless they show at least four-hourly measurements, are therefore quite misleading. There is, as a rule, no apyrexial period, but a remission of two or three degrees normally occurs at some period of each day. In cases of moderate severity the highest diurnal temperature is about 102° or 103° F.; in severe cases it may be 104° or 105° F. Generally speaking, the pyrexia is higher and shows wider fluctuations [illegible] in sapræmia.

[illegible]ile the temperature is, as a rule, a fair index of the [illegible]y of the infection, its prognostic importance must not be over-estimated, severe pyrexia being not incompatible with recovery. On the other hand, very severe or rapidly fatal cases may occur without very high temperature.

Pulse.—The pulse-rate is always rapid, and is to a great extent independent of the temperature. The pulse may be over 120 with a temperature of only 101°–102° F.; this relation of the pulse and temperature in puerperal illness, in the absence of such complications as profound anæmia, is an almost certain indication of septicæmia. Slight diurnal variations follow the fluctuations of temperature. The volume of the pulse is small, and the tension low in severe cases. The rate and tension of the pulse are of great importance in prognosis; a persistent pulse-rate of over 120 being of grave significance.

The Pelvic Organs.—In a case of pure septicæmia, the uterine cavity will be found empty, and involution, as a rule, will not be markedly arrested; there will, therefore, be no undue enlargement or tenderness of the uterus. The lochial discharge usually ceases early in a severe case, and when present may show no sign of decomposition. On vaginal examination no local signs of pelvic inflammation will be found, but vulval, vaginal, or cervical lacerations may show signs of local infection.

General Symptoms.—*Vomiting* is of serious import, especially when associated with abdominal distension and rigidity; in bad cases it may be persistent, and after some time the vomit may become black from admixture with blood, even when the case is not complicated by peritonitis. In moderately severe cases there is, as a rule, no vomiting. *Diarrhœa* is a serious but infrequent symptom; it may be produced by the incautious use of strong mercurial solutions for intra-uterine injection, and in such cases other signs of mercurialism should be sought for. *Sleeplessness*, often accompanied by severe headache, may be met with, and is to be regarded as another unfavourable sign. *Cutaneous rashes*, of erythematous or papular type, are not uncommon; they are usually transient, and may disappear in one part to reappear in another. Profuse sweating is common, and may lead to an eruption of sudamina. The *tongue* at first is moist but furred; as the disease progresses it becomes dry, and in very severe cases brown and cracked, while sordes collect around the teeth.

The *intelligence* is usually unimpaired, even in fatal cases, almost up to the moment of death, but delirium passing into coma sometimes supervenes as the end approaches. The *mammary secretion* becomes suppressed in severe cases after the first few days. *Abdominal pain* is almost invariably absent.

Diagnosis.—Considerable practical importance attaches to bacteriological examination of the uterine lochia. For clinical purposes lochial swabs may be taken as follows: the vaginal canal should first be well douched; a large-size Fergusson's speculum should next be passed so as to expose the portio vaginalis and shut off the vaginal walls; the surface of the portio vaginalis and the cervical canal should next be carefully cleansed by swabbing; a short sterilised glass tube is then passed into the cervix, and a sterile swab carefully passed without contact into the tube and pushed up to the fundus. Swabs of lochia thus taken from the interior of the uterus may yield pure cultures of streptococci or staphylococci; or mixed growths of these organisms with the bacterium coli and the pneumococcus may be obtained. Bacteriological examination of the vaginal secretion is useless for diagnosis; it has been sometimes found sterile when the uterine lochia contained pyogenic cocci, but it usually contains pathogenic and non-pathogenic organisms even when the uterus itself is not infected. In some cases pyogenic cocci can also be demonstrated in the blood, although too much importance should not be attached to their absence.

It must be borne in mind that a mild fever of either sapræmic or septicæmic type may be caused by infection of wounds of the lower part of the genital tract—cervix, vagina, vulva, and perineum—while the uterus itself remains free from infection. These parts should accordingly always be examined, and the condition of wounded surfaces carefully noted.

In the absence of bacteriological proof, diagnosis can only be made by exclusion, and it should be the rule to regard as septic in origin all cases of pyrexia in the puerperium for which some other cause cannot be clearly demonstrated. Such disorders as influenza, scarlet fever, and enteric may no doubt attack lying-in women and produce a train of symptoms resembling those of septicæmia; but they must never be loosely diagnosed, although the temptation to do so may sometimes be difficult to resist. The distinction between sapræmia and septicæmia may often be made by attention to the condition of the uterus and the lochia, and to the effects of intra-uterine disinfection.

Prognosis.—At the onset of a case of uterine infection the prognosis must always be guarded. If a well-marked improvement follows the local treatment described later on, the prognosis is good, for the infection is mainly sapræmic. Yet a case which begins as one of sapræmia may later on develop into one of generalised infection. In a case of simple and uncomplicated sapræmia the prognosis is always good, and practically all cases end in recovery. In septicæmia the prognosis is much less favourable than in sapræmia, because the infection is more virulent in type, and the general symptoms are more severe.

The course of septicæmia may be greatly prolonged; after considerable improvement has occurred, serious relapses may supervene, and local affections such as phlegmasia or salpingitis may appear. Sometimes the case terminates in pyæmia. A moderate degree of leucocytosis (10,000 to 15,000) is usually found in puerperal septicæmia. The maintenance of this degree is of good prognosis; a sudden fall is of serious import, and a rapid rise associated with the formation of localised inflammatory effusions usually indicates suppuration. The symptoms of gravest prognostic significance are the following:

(1) Pulse-rate persistently over 120.
(2) Persistent vomiting, with dry brown tongue.
(3) Sleeplessness.
(4) Repeated severe rigors.
(5) Inability to take sufficient nourishment.

Estimates by different observers of the rate of mortality of puerperal septicæmia vary greatly. Thus Krönig and Whitridge Williams have each reported 50 cases of streptococcic infection with a mortality of only 4 per cent. On the other hand, a series of one hundred recent cases of streptococcic infection collected from various sources by the American Gynæcological Society yielded a mortality of nearly 30 per cent. The prompt recognition of the condition, and the prompt adoption of suitable treatment, will always favourably influence the patient's chances of recovery.

Treatment.—The importance of the prophylaxis of puerperal infection by strict antiseptic routine, by avoidance of unnecessary examination or operative interference, and by the careful and proper management of the third stage of labour, have been already frequently insisted upon. When once the disease has manifested itself, treatment must be promptly applied, for, like most wound-infections, only in the earliest stages can its spread be controlled. Inasmuch as the differential diagnosis of sapræmia and septicæmia can seldom be made immediately, the initial treatment must follow the same general principles for all cases, and will depend upon the severity of the symptoms rather than the nature of the infection.

Mild type.—Temperature 101° to 102° F.; no shivering or rigor; headache slight; uterus large; lochia often but not always offensive (fig. 222). Such cases are probably sapræmic, and the dose of toxins absorbed into the general circulation is small. They can usually be cured by hot vaginal douching with a mild antiseptic (lysol ʒss. to Oj.), ergot in full doses (ergotin gr. iij. three times a day), and free purgation. Douching and the administration of ergot, by stimulating the uterine muscle, promote drainage and assist the expulsion of retained dead tissues; purgation assists the elimination of the absorbed toxins. In two or three days the symptoms will subside.

Severe type.—Temperature 102° to 103° F. with or without a rigor; pulse 100–120; headache and general malaise well marked; condition of lochia unimportant, but may be scanty and inoffensive or profuse and fetid (fig. 223). In all such cases it is best to begin the treatment by careful and thorough disinfection of the uterine cavity. It will be remembered that in sapræmia the chief focus of infection is the wall of the uterus, which shows the changes described as *putrid endometritis.* This can only be adequately dealt with by clearing all débris out of the uterus, and thoroughly, and sometimes repeatedly, douching the uterine cavity with a suitable antiseptic solution.

In clearing out the uterus, an anæsthetic, although not always necessary, is desirable because it allows of the operation being more thoroughly performed. The patient should be placed in the modified lithotomy position, and the operator should protect his own hands from infection by wearing sterilised rubber gloves. A swab for bacteriological diagnosis may be first taken. Mechanical dilatation of the cervix is never required during the first week of the puerperium. After thoroughly douching and swabbing the vulva and vagina, one or two fingers can be passed directly into the uterus, and the walls carefully scraped with the protected finger-tip until all débris has been removed. Pieces of adherent membrane or placenta may be encountered, the separation of which will cause fairly free bleeding. A blunt wire curette (fig. 224) may be used for scraping the walls, but the ordinary sharp curette should not be employed during the first week of the puerperium; this instrument removes too much of the soft uterine wall, destroys the protective leucocytic zone, and opens up channels through which generalised infection may occur. It may also very easily perforate the uterine wall. It is of little use to douche the uterus without first clearing the walls in this way; for douching alone will not detach adherent fragments of placenta or membrane.

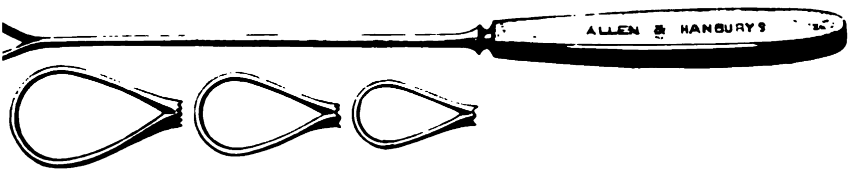

FIG. 224.—BLUNT CURETTE.

The uterine cavity should then be douched with three or four pints of a hot antiseptic solution (115° F.). Suitable solutions for this purpose are lysol, izal, cyllin (℥ss. to Oj.), or tincture of iodine (℥j. to Oj.), or carbolic acid 1–60, or biniodide or perchloride of mercury 1–4,000; if the latter is employed a quart of normal sterile saline solution, or plain boiled water, should be used immediately afterwards to wash out any of the mercurial solution which might otherwise remain in the uterus and become absorbed. If this precaution is adopted there is no risk of mercurial poisoning. The action of the intra-uterine douche is chiefly mechanical, its bactericidal powers being probably very small. In douching the uterine cavity a long glass nozzle with a grooved return channel, such as that shown in fig. 225, should be employed; it can be sterilised by boiling. Care should be taken to maintain full uterine retraction afterwards by abdominal massage and by the administration of ergot in full doses; retention of clot from the oozing surfaces will thus be prevented. Before exploring the uterine cavity, lacerations of the lower part of the genital tract should be looked for and their condition carefully noted. They will usually be found unhealthy, with more or less sloughing; they should be carefully cleansed by swabbing, and then freely painted with pure carbolic or chromic acid.

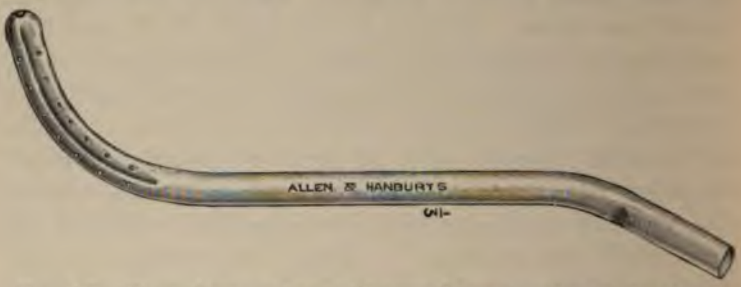

Fig. 225.—Glass Intra-uterine Douche Nozzle, grooved to allow a return flow.

If the case is one of simple sapræmia, this treatment, combined with the administration of purgatives, in most cases rapidly cures the patient. Temperature and pulse fall to normal in two or three days, or even sooner, as the toxins are eliminated; reduction in size of the uterus takes place; the lochia become once more odourless and usually very scanty in amount. No further local treatment is then required except that the vagina should be douched twice daily for several days. Complete failure of this treatment indicates that generalisation of the septic process has occurred.

When it appears probable that the case is one of septicæmia, three lines of treatment are available—viz. (a) *specific*, (b) *general*, and (c) *surgical*.

(a) *Specific Treatment* consists in the administration of an antitoxic serum. Antitoxic sera can at present be obtained for streptococcic, staphylococcic, and bacillus coli infection; for the numerous other organisms which may be concerned in producing puerperal infection physiological antidotes are not available, with the exception of the diphtheritic and possibly of the typhoid bacilli. It is generally believed that streptococci are the most virulent of the pyogenic cocci, and antistreptococcic serum has accordingly been freely used in puerperal septicæmia, even when a bacteriological diagnosis has not been made. The results of its use have been, on the whole, unsatisfactory. This is probably to be attributed in part to the fact that streptococci are not always the infecting organisms, and in part to the fact that there are many different species of streptococci, each requiring its own antitoxin ; it is therefore difficult to prepare a serum which will efficiently antagonise the species which may chance to be present in a particular case. An attempt to do so has been made in the preparation of the *polyvalent serum*, which is obtained from an admixture of various species of streptococci. Such a serum may also be prepared from successive generations of organisms taken from the case of puerperal septicæmia under observation. This appears theoretically to be much more likely to be efficient than any other. It is a principle now somewhat widely applied in the treatment of many cases of chronic suppuration, such as furunculosis, acne, pyorrhœa alveolaris, &c., in which, after isolation from the pus of the organism concerned, a vaccine is prepared from it by cultivation. In applying specific treatment, exact bacteriological diagnosis is obviously of great importance. In the rare cases which appear to be due to the diphtheria or typhoid bacilli, the special sera of these organisms may be administered.

Antistreptococcic serum should be given by subcutaneous injection in the abdominal wall or the thigh. The first dose should be at least 15 c.c., which may be repeated every twelve hours for several days; larger doses have been frequently given without ill effects. Improvement is indicated by fall of temperature and pulse, cleaning of the tongue, and amelioration of the general symptoms. If no improvement follows, it is useless to persist. Its injection in similar dose into foci of infection, such as pelvic inflammatory effusions, has also been recommended.

(b) *General Treatment.*—The most important points are (1) the administration of fluid nourishment in large quantity; (2) control of vomiting, diarrhœa, and sleeplessness; (3) reduction of temperature when it rises over 104° F.;

(4) administration of alcohol in large amount, and cardiac stimulants such as strychnine when exhaustion supervenes; (5) subcutaneous injection of normal saline solution to stimulate phagocytosis and promote elimination of toxic products by diuresis and diaphoresis.

It is unnecessary to enter in detail upon the methods of fulfilling these indications, which are matters of general medical teaching. The ordinary hypnotic remedies such as trional or veronal, given with full doses of brandy, will usually produce sleep. Temperature will be best reduced by the cold pack, or by rubbing the body with lumps of ice; antipyretic drugs should be given sparingly on account of their depressing action. Quinine is often administered in the belief that it exerts a specific action, but its effect is probably only antipyretic. The methods of injecting normal saline solution have been already described.

(c) *Surgical Treatment.*—Attempts have been made in recent years to show that removal of the uterus is capable of favourably influencing the course of severe cases of puerperal septicæmia. Advocates of this operation contend that as the uterus is the chief, if not the sole, focus of infection, its removal will arrest the continuous passage into the circulation of fresh organisms and toxins, produced by the active bacterial development proceeding in it. It is, however, certain in severe cases of septicæmia that widespread dissemination of organisms which multiply in the lymph or blood streams has already occurred; removal of the uterus under such circumstances cannot arrest, although it may modify, the general infective process, and therefore is not to be regarded as a radical operation. The latter view is upheld by the unfavourable results of this operation, for up to the present it has not been shown to increase the patient's chances of recovery. When there is evidence of abscess formation in the uterine wall, the removal of the uterus by the vaginal route may be necessary.

2. **General Puerperal Peritonitis.**—The results of post-mortem examinations show that this condition is infrequent. Some of the symptoms of general peritonitis—*e.g.* continuous vomiting, meteorism, irregular pyrexia, and a rapid small pulse—are met with in puerperal septicæmia. The clinical diagnosis of general peritonitis accordingly presents unusual difficulties in cases of puerperal infection. A systematic

description of the clinical features of this affection is unnecessary in a text-book of midwifery, for it differs little from general peritonitis due to surgical causes. The prognosis is almost hopeless, but free drainage, suprapubic, vaginal, and lumbar, should be established as soon as the diagnosis is made, and the same general and specific treatment applied as in cases of puerperal septicæmia.

3. **Local Pelvic Inflammation.**—A well-defined group of cases of puerperal infection may be recognised, of which the main feature is the presence of pelvic inflammatory lesions—*i.e.* of course, lesions outside the uterus. In such cases the inflammatory process is seldom limited to a single tissue or a single organ, yet it ordinarily manifests itself chiefly in either the *pelvic peritoneum*, the *pelvic cellular tissue*, or the *uterine appendages*. Thus, in pelvic cellulitis more or less extensive peritonitis is usually found as an accompaniment, while in pelvic peritonitis the Fallopian tubes and ovaries are necessarily implicated to a greater or less extent. The relative frequency of occurrence of this group of local puerperal infections is probably not more than 1 in 10 of all cases. The original focus of infection is in almost all cases the uterus; thence the process spreads by direct continuity through the Fallopian tubes to the pelvic peritoneum, or through a cervical tear to the cellular tissue; or it may spread through the lymphatics of the uninjured cervix to the cellular tissue; or through the lymphatics of the uterine wall to the peritoneum. Occasionally the veins appear to be the chief channels of infection, and a spreading phlebitis occurs which may pass downwards to the femoral vein, or upwards to the inferior vena cava. The comparative rarity with which localised pelvic inflammation follows uterine infection is probably due, in some way, to the protection afforded by the zone of leucocytic activity in the infected uterine wall (see p. 414).

Common Features.—Cases of puerperal pelvic inflammation are probably due to pyogenic organisms of somewhat attenuated virulence, or to auto-infection by the diplococcus gonorrhœæ; sometimes also to bowel infection by the bacillus coli communis. It is usually stated that they are characterised by a late onset, but this is not strictly accurate. Severe symptoms do not as a rule appear until the latter half of the first week—*i.e.* about the fifth or sixth day, but slight symptoms of uterine infection, too often overlooked, are almost always present earlier than this. When such symptoms as moderate elevation of temperature and decomposition of the lochia are disregarded, the real onset of the disease is naturally misunderstood. It is quite possible that if due heed were paid to the significance of these symptoms in such cases, the appearance of the local inflammation might be altogether prevented by early and appropriate treatment. A rigor often occurs, and pelvic pain, practically unknown in sapræmia and septicæmia, is a prominent symptom of the onset of some of these affections. Their general course is prolonged, localised suppuration is not uncommon, but a fatal termination is rare. Mild cases, not marked by an acute onset, are probably of frequent occurrence, and, being overlooked or inadequately treated, pass into the phase of *chronic pelvic inflammation* so often met with in parous women of all classes of life.

Pelvic Cellulitis (synonyms: Parametritis, Broad-ligament Phlegmon).—Systematic descriptions of this affection are usually given in text-books of gynæcology; a few points only require notice in the present connection.

A cellulitic effusion forms a hard immovable, non-tender swelling which may fill the entire pelvis and surround the uterus; or may be limited to, or chiefly apparent in, one or other broad ligament. In the former case the position of the uterus is unaltered; in the latter the uterus is displaced to the unaffected side. Spreading along the cellular tissue planes it may pass upwards to the iliac fossa and the anterior abdominal wall, forming a swelling palpable by abdominal examination above the inner half of Poupart's ligament, or may track upwards along the ilio-psoas muscle to the region of the kidney.

In some cases a small effusion only is met with, which subsides in from one to two weeks; more frequently it is extensive and persists for several weeks, but ultimately becomes absorbed; sometimes suppuration occurs, indicated by sharp irregular rises of temperature, rigors, exacerbation of pain, and marked increase in the degree of leucocytosis—always present in pelvic inflammation. Cellulitic abscesses usually point either above Poupart's ligament, or in one or other lateral vaginal fornix; more rarely they rupture into the rectum or bladder. Occasionally they pass out of the pelvic cavity through the sciatic or obturator foramina, to appear in the buttock or the anterior aspect of the thigh. In rare cases of extensive effusion absorption takes place around the uterus, leaving the pelvis practically free, while outlying parts of the effusion persist and ultimately suppurate, forming abscesses in such situations as the iliac fossa or near the kidney. This condition has been named *remote parametritis.*

Pelvic Peritonitis (*Perimetritis*) *and Salpingo-oophoritis.* A *peritonitic* pelvic effusion usually occupies the pouch of Douglas; it therefore forms a swelling behind the uterus, and when of large size it displaces this organ forwards. It is of softer consistence than a cellulitic effusion, and usually tender to touch. A roof of matted tissues, comprising omentum and large or small bowel, is formed above it; this roof is recognisable as an abdominal swelling occupying the hypogastrium, tender to touch, ill-defined in outline, and sub-resonant on percussion. These effusions rarely suppurate; when suppuration does occur the resulting abscess may be spontaneously evacuated either into the vagina, the rectum, or some other part of the bowel. Spontaneous absorption without formation of pus occurs in the majority of cases, and is usually more rapid than in the case of cellulitis.

Acute tubal or *ovarian inflammation,* leading to the rapid formation of a pyosalpinx or an ovarian abscess, is rarely met with in the puerperium. Chronic inflammatory affections of these organs, insidious in onset, and not leading immediately to acute symptoms, are, however, not uncommon sequels of puerperal infection; they are usually overlooked until the appearance of some complication or the chronic ill-health of the patient leads her to seek advice.

Cystitis may occur in the puerperium from careless use of the catheter, but it does not differ from the same condition as met with under other circumstances.

Phlebitis.—Inflammation of the pelvic veins no doubt usually accompanies peritonitis and cellulitis, but it is limited to the affected areas. Clinical diagnosis of this condition is impracticable, and therefore need not be further considered. Phlebitis may, however, occur in lying-in women in the great veins of the lower limbs, or much more rarely in the upper limbs, giving rise to the condition known as phlegmasia alba dolens, which will be considered in the next section.

Treatment of Local Pelvic Inflammations.—The general and specific treatment of septicæmia is applicable to these cases also. Disinfection of the uterine cavity should be practised promptly upon the appearance of acute local symptoms, and before the pelvic inflammatory effusions have had time to become extensive. At periods later than this intra-uterine treatment is of little use. Prolonged confinement to bed, with careful feeding and nursing, and attention to the daily evacuation of the bowels, will in most cases lead to the absorption of the effusion. Collections of pus should be evacuated without delay, the incision being made in the position indicated by softening; but the diagnosis of suppuration is sometimes difficult, for the abscess may form in a position inaccessible to clinical examination. Careful and repeated estimation of the number of leucocytes in the blood may be of great assistance in diagnosis; when the number present is 25,000 per cm. or over, with a high percentage of eosinophile cells, the presence of pus is highly probable.

4. **Phlegmasia alba dolens (White Leg).**—This condition when well marked consists in a general swelling of the affected limb from the foot to the groin; its onset being attended by severe pain, pyrexia, and general malaise. Although in the great majority of cases it affects the lower limbs only, in a few rare cases an upper limb has been simultaneously or subsequently attacked. Two varieties, the *thrombotic* and the *lymphatic*, may be distinguished.

Thrombotic Form.—In this, the most frequent form, the immediate cause of the swelling is phlebitis of the femoral vein, leading to thrombosis and consequent obstruction to the venous return from the limb. In the upper part of Scarpa's triangle the thrombosed vein can be readily felt as a firm, somewhat nodular, and tender thick cord. The swelling of the limb is due to rapidly developing œdema, which appears first in the foot and quickly extends to the thigh; the swollen parts are soft and pit on pressure, and are at first of a dusky blue rather than a white colour. Usually the femoral vein is involved by continuous spread from similarly affected uterine or pelvic veins; sometimes, however, no evidence of pelvic phlebitis can be obtained clinically. But the condition is almost certainly septic in all cases, and streptococci have been found in the femoral clot by Widal. Probably these organisms, circulating in the blood-stream, may set up phlebitis in a remote part, by attacking the endothelium of the vein-wall. Slight cases of this variety, in which only the foot and leg are affected, are not uncommon.

Lymphatic Form.—In some cases no signs of femoral thrombosis can be found; the swollen limb has a tense, white, glistening appearance, and does not pit on pressure; there may be enlarged and tender lymphatic glands felt in the groin. In the early stages the skin shows a slight flush, and later on small areas of dermatitis or superficial gangrene may appear. It is stated that in such cases the effused fluid in the limb is not serum (as in œdema), but coagulable lymph. It is much rarer than the thrombotic form, and is probably due to lymphatic infection setting up a deep cellulitis in the affected limb. It is, of course, septic in nature.

It is not at all infrequent for cases to be met with in which both factors, thrombosis and lymphatic infection, occur, giving rise to swelling of atypical characters.

Although sepsis must be regarded as the essential cause of phlegmasia, certain contributory causes must also be recognised; of these the most important is hæmorrhage during or after labour; others are multiparity and general ill-health, especially blood diseases. The frequency of phlegmasia has greatly diminished since the general adoption of antiseptic principles in the practice of midwifery.

Clinical Features.—A more or less acute onset is characteristic of this affection. It occurs in the great majority of cases in the latter half of the second week of the puerperium (tenth to fourteenth day), although it may appear as early as the sixth or as late as the thirtieth day. Acute pain is felt in the affected limb, and the temperature may rise rapidly to 102° or 104° F.; slight shivering or sometimes a well-marked rigor may accompany these symptoms. There has often been a certain amount of pyrexia during the first puerperal week, as is the case with the local pelvic inflammations—*i.e.* asepsis has not been successfully maintained (fig. 226). The acute pain and the fever last from three or four days in a mild case, to ten or twelve days in a severe one; then both subside concurrently. In the thrombotic form, tenderness and induration will be found along the line of the femoral vein. The affected limb is immobile as if from paralysis, and

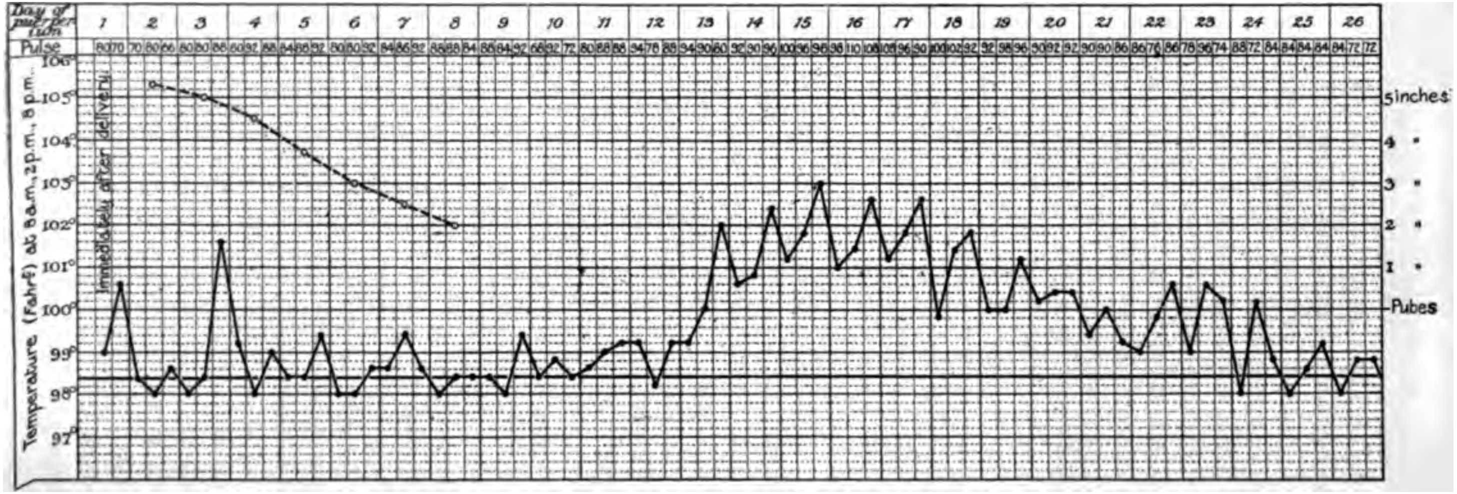

FIG. 226.—CHART OF A CASE OF PHLEGMASIA DOLENS SHOWING THE ONSET AND THE PERIOD OF PYREXIA.

frequently the presence of fluid can be detected in the knee-joint. The temperature of the affected limb is about half a degree higher than that of the sound one. The left leg is much more commonly affected than the right; this is no doubt due to the preponderating frequency of the first position of the vertex, which makes cervical laceration much more common on the left than on the right side, and predisposes to infection of the left broad ligament, its vessels and lymphatics. Both limbs are affected in about one-third of the cases, but almost always consecutively after an interval of one or two weeks, a simultaneous onset of the disease in both limbs being extremely rare. From recent statistics it appears that phlegmasia occurs about once in four hundred cases of labour. Cases in which the upper limb becomes affected are very uncommon.

Treatment.—Treatment should be chiefly directed to the immobilisation of the affected limb, and the relief of the local pain. Almost the only risk attending the disease is pulmonary embolism from detachment of a portion of blood-clot from the thrombosed vein. To prevent the occurrence of this accident, the limb should be slung in a cradle, or laid upon pillows and immobilised by placing heavy sandbags in contact with it on either side, from the hip down to the foot. Voluntary movement must not be allowed for three to four weeks after the cessation of all febrile symptoms. Many weeks or even months may elapse before all the swelling has disappeared from the limb, and a certain amount of pain and stiffness on movement may persist for even longer periods. Pain is best relieved by the application of moist heat, in the form of hot fomentations, to which lead and opium or belladonna lotion may be added. After the pain has disappeared the limb must be kept carefully wrapped up in cotton wool, and shielded from pressure with a 'cage.' In cases of unusually acute onset attended with a rigor, antistreptococcic serum may be employed. The administration of citric acid in ten-grain doses three times daily is believed to retard the spread of the clot by diminishing the coagulability of the blood. Massage is useful in the later stages when pain and swelling persist.

5. **Pyæmia** results from the passage of infected thrombi into the circulation from an infected clot in one of the

uterine or pelvic veins. The dislodged particles may set up infective endocarditis or broncho-pneumonia, or, passing through the lungs, may become lodged in distant parts, organs frequently attacked being the spleen and the synovial membranes of the large joints. No part of the body is, however, exempt from the occurrence of metastatic abscesses in this affection. Frequently a succession of infected thrombi are dislodged at irregular intervals, leading to the formation of a series of abscesses in various parts. Or local swellings which do not suppurate may be formed in this way.

The onset of puerperal pyæmia cannot, as a rule, be distinguished from that of other varieties of puerperal infection; an acute onset with rigors is commonly met with. It then manifests itself as a *hectic fever*, the temperature being remittent, with an evening rise and a morning period of apyrexia. Profuse sweating and rapid loss of flesh are met with; but the disease is not as formidable as puerperal peritonitis, and recovery usually occurs, although the illness may run a very prolonged course. In addition to the general treatment described in connection with septicæmia, local effusions, whether purulent or serous, should be evacuated whenever they are so situated as to be accessible to surgical treatment.

Inflammation of the Mammary Glands (Mastitis, Mammary Abscess)

Unless proper precautions are observed during the process of suckling, the mammæ may become infected by various pathogenic and pyogenic organisms which gain access to it usually through superficial skin-cracks, or sometimes, possibly, through the ducts which open upon the nipple. Recent bacteriological observations show that bacteria are present in human milk in 86 per cent. of pregnant and 91 per cent. of lying-in women. Some bacteriologists have stated that staphylococci can often be found in the milk-ducts of healthy nursing women when the glands appear to be normal. It seems probable, therefore, that the importance assigned by clinical observations to nipple-cracks in the production of mastitis has not been over-estimated; for if these organisms may occur in the milk-ducts without causing inflammation, it must be their entrance into the lymphatics through a wound of the surface which sets up the process. The physiological engorgement of the breast at the beginning of lactation, which reaches its height on the fourth day, does not lead to mastitis unless infection also occurs through one of the channels just indicated. The inflammation may occur (1) in the subcutaneous cellular tissue—usually under or near the areola (*pre-mammary abscess*); (2) in the substance of the gland (*intra-mammary abscess*); (3) in the sub-glandular connective tissue (*retro-mammary abscess*); the last-named variety seldom follows infection through the nipple, but usually results from empyæma, or disease of the ribs. The foci of infection are often multiple; suppuration frequently but not invariably occurs, and abscesses sometimes form in more than one, or even in all three, of the localities just indicated. Mastitis may occur during pregnancy, but this is rare; in the puerperium it most commonly occurs during the first two or three weeks, but may be met with much later than this.

The onset of mastitis is attended with diffused redness and severe pain in the affected gland, a rapid rise of temperature, headache, and other signs of general malaise; then a firm and very tender swelling appears at some part of the gland. Suppuration may be attended by rigors, and the usual local signs—softening of the inflamed area, with œdema of the skin, or redness and tension if the abscess is superficial. A *pre-mammary* abscess sometimes opens spontaneously upon the surface or into a large milk-duct, leading to the discharge of pus through the nipple. The diagnosis of a *retro-mammary* abscess may present difficulty, but upon this subject a text-book of surgery should be consulted. Sometimes both glands are affected, but seldom simultaneously, the second probably becoming directly infected from the first through suckling or through lack of surgical cleanliness.

Treatment.—The prophylaxis of mammary inflammation consists in the proper management of the breasts during pregnancy and suckling, which has been already described. When nipple-cracks are promptly and thoroughly treated, mastitis very seldom ensues. If, owing to the death of the child or for any other reason, the mother does not suckle, the nipples should be carefully disinfected in the manner described on page 404, and the breasts protected by cotton-wool and tightly bandaged. If they become very painful, the bandage may be removed and an evaporating lotion (*e.g.* eau de Cologne and water) employed for a few hours, and the bandage then re-applied. A saline or other aperient should be given daily for the first two or three days. Continuous pressure with the aid of free purgation will, as a rule, quickly arrest the activity of the glands. The local application of belladonna and the administration of potassium iodide are seldom required, but may be resorted to if difficulty is experienced in arresting the secretion.

The first signs of inflammation in the breasts should at once be met by the following measures: (1) cessation of suckling from the affected gland, the secretion being drawn off as required with a breast-pump; (2) the local application of moist heat (hot fomentations), or preferably of cold by the use of Leiter's coils through which a stream of iced water can be run; (3) purgation. If the breast is extensively affected, or if signs of suppuration occur, suckling must be entirely suspended, the unaffected gland tightly bandaged under cotton wool to secure even pressure, and suppurating areas promptly laid open when recognised. The incisions should be made as far as possible parallel to the course of the large milk-ducts which converge upon the nipple. The abscess cavity is frequently multilocular and of irregular shape; septa must be broken down with the finger to ensure efficient drainage of all parts of the cavity, and a counter-opening at some dependent part may be required. Rubber tubes should be used for the first few days and the cavity washed out daily with an antiseptic solution—*e.g.* carbolic-acid lotion 1-60. Tonics such as iron and quinine are always indicated during convalescence, which may be prolonged when the general health is unsatisfactory. The functional adequacy of the gland in a subsequent pregnancy as a rule is not affected, for the amount of gland tissue destroyed by suppuration is usually small. Sometimes, however, the gland is so disorganised by multiple foci of suppuration that its removal becomes necessary.

Puerperal Hæmorrhage: Secondary Post-partum Hæmorrhage

Hæmorrhage may occur at almost any period of the puerperium, and may be due to a variety of different conditions. In *slight cases* it takes the form of an undue amount of bleeding during the first three days, undue prolongation of the hæmorrhagic stage of the lochia, or recurrence of bleeding after the lochia have become serous. Such cases may be due (*a*) to retention in the uterus of a small portion of placenta or chorion, or blood-clot, which may or may not become infected; (*b*) to delayed involution caused by not suckling, or by general ill-health; (*c*) to uterine congestion caused by cardiac or hepatic disease, by backward displacement of the uterus, by getting up too soon, or by constipation.

In *severe cases* a sudden severe hæmorrhage may occur or there may be continuous bleeding of moderate but not alarming extent, or irregular profuse losses of blood. Such cases are due to (*a*) sudden relaxation of the uterus in the first few days of the puerperium from nervous shock; (*b*) to the *separation* of retained pieces of placenta of considerable size, especially if they become infected; (*c*) to the formation of a placental polypus; (*d*) to puerperal inversion of the uterus; (*e*) to the presence of new growths in the uterus—*e.g.* a fibroid which has become infected or is being extruded into the uterine cavity, carcinoma of the cervix, or lastly chorionepithelioma (deciduoma malignum).

Most of these conditions and their treatment have been already discussed in connection with labour, but the clinical association of chorionepithelioma with the puerperium is of considerable importance, and a short description of this disease is accordingly necessary.

Chorionepithelioma

(Synonyms: Deciduoma malignum; syncytioma malignum; carcinoma syncytiale.)

Chorionepithelioma is a malignant tumour arising either in immediate, or more or less remote, connection with pregnancy, and situated most commonly, but not invariably, in the uterus; in this organ it forms a soft hæmorrhagic growth occupying the usual site of the placenta—*i.e.* the fundus and adjacent portions of the anterior and posterior uterine walls (fig. 227). The primary growth may, however, be situated in the vaginal walls, the labium majus, the Fallopian tube, or the ovary. The disease is characterised clinically by the occurrence of irregularly recurrent and often violent hæmorrhages in the puerperium, following an abortion or, more rarely, a full-time labour; the interval between the end of pregnancy and the onset of these symptoms is, however, very variable. Other symptoms quickly appear—viz. a foul discharge, progressive anæmia, cachexia, fever, and sometimes rigors. Metastatic growths are quickly formed, and in many cases this tumour destroys life with almost unexampled rapidity. After much discussion, and many contradictory observations, it has now been definitely proved that it arises from the chorionic epithelium, both layers of which are represented in the specific cellular elements of the tumour. It therefore is clearly of embryonic, not maternal origin.

Microscopical Characters.—The cell elements which are typical of this tumour are the following (fig. 228*b*): (1) large irregular multinucleated masses of protoplasm (plasmodia) in which cell boundaries cannot be recognised; these are derived from the syncytium; (2) small polyhedral cells with large nuclei lying in closely packed masses; these are derived from Langhans's layer; (3) large mononucleated cells, and multinucleated giant cells, collected in masses, or invading the stroma of the uterine tissues: these are probably derived from both (1) and (2). In addition to these elements, definitely recognisable chorionic villi are sometimes present, either of normal appearance or in a condition of hydatidiform degeneration; from these villi the origin of the three varieties of cells just described has been traced by a number of different observers (fig. 228*a*). The tumour elements show remarkable powers of invasion; they attack the uterine tissues, and perforate the walls of the blood-vessels (usually veins), and thus become disseminated by the blood-stream. This accounts for the unusually rapid formation of metastases. The tumour tissues themselves contain much effused blood and tend to undergo rapid necrosis; the greater part of the growth is usually found to consist of débris of broken-down tissue and clot; only at the growing edge can the characteristic elements be found.

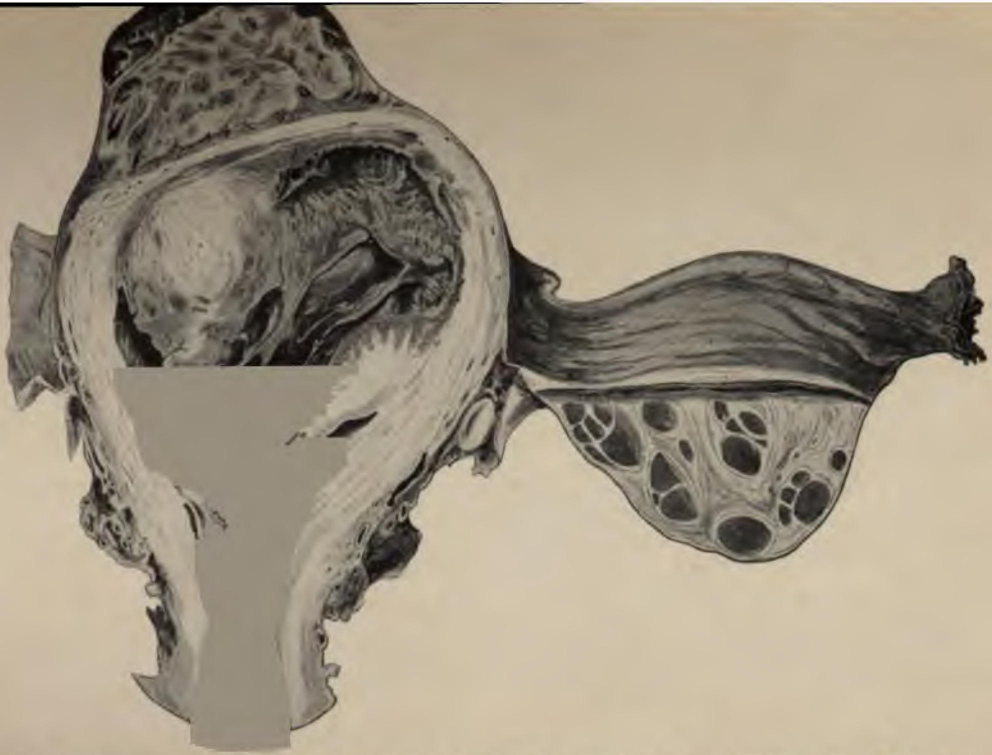

Fig. 227.—Chorionepithelioma: Hemi-section of the Uterus and Right Appendages. The growth arises in the upper part of the Uterine Cavity and has nearly perforated the Fundus. The Ovary shows a number of Lutein Cysts.

[*To face p.* 442.

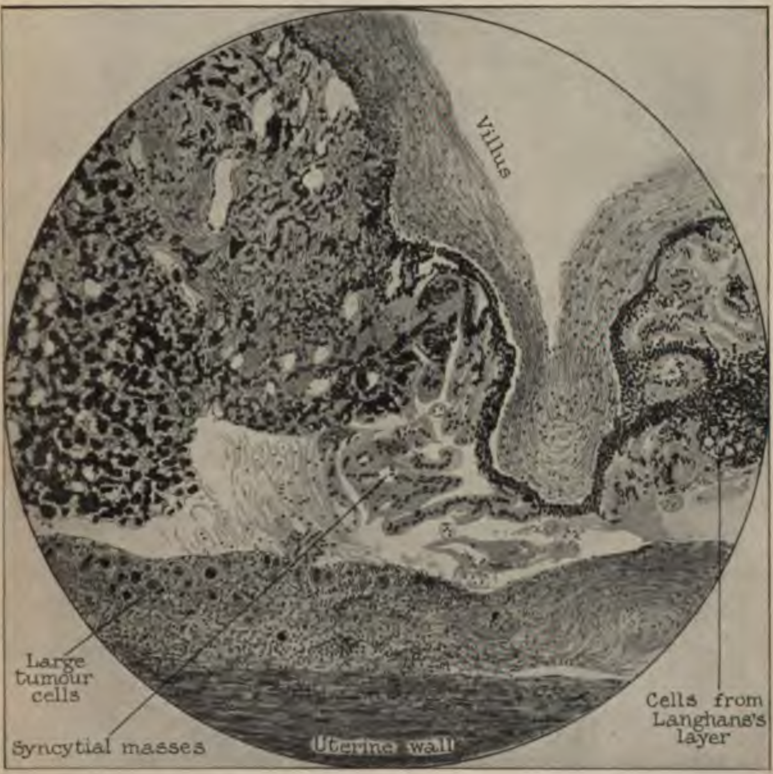

FIG. 228a.—CHORIONEPITHELIOMA: LOW POWER; SHOWING THE ORIGIN OF THE PLASMODIA AND CELLULAR ELEMENTS FROM A VILLUS. (TEACHER.)

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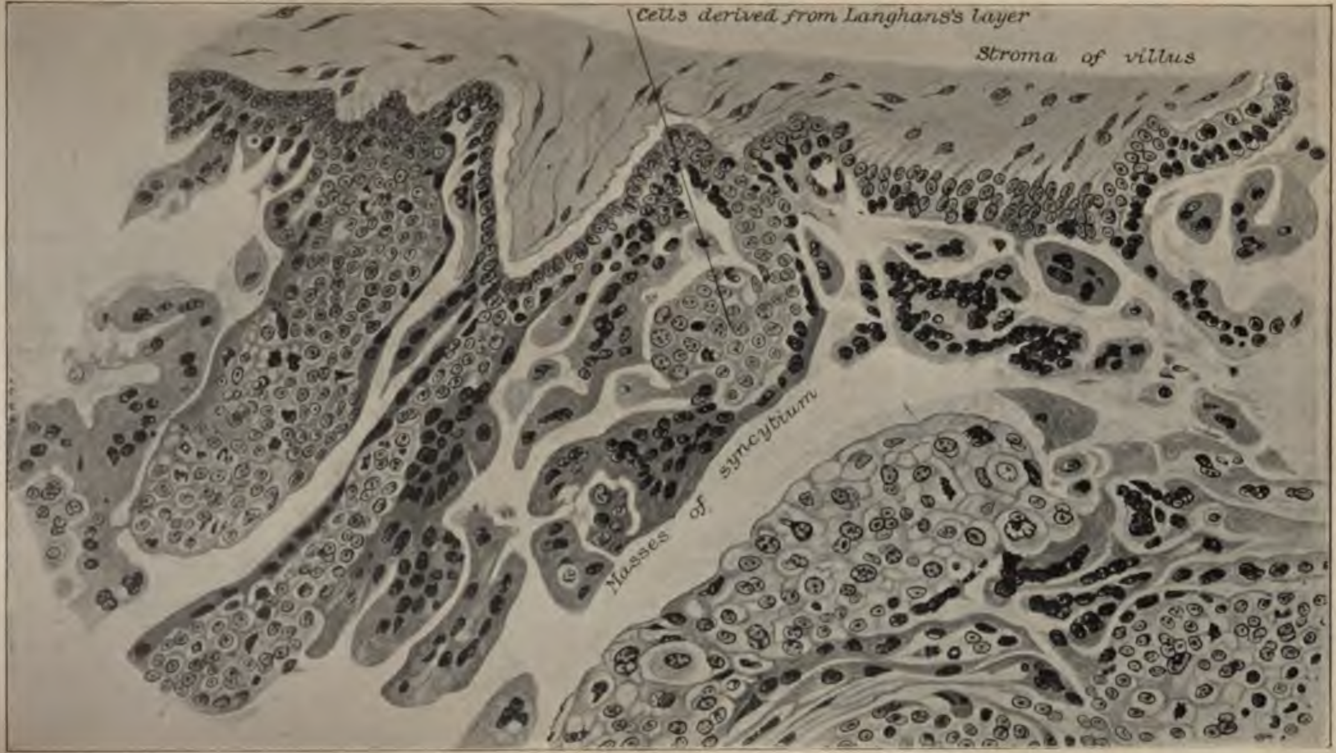

FIG. 228*b*.—CHORIONEPITHELIOMA; SHOWING THE CHARACTER OF THE PLASMODIA AND CELLULAR ELEMENTS. A PORTION OF FIG. 228*a* MORE HIGHLY MAGNIFIED. (TEACHER.)

[*To face p.* 442.

The striking resemblance of the cell elements of this tumour to the malignant or perforating variety of hydatidiform mole has been referred to on a previous page; this constitutes one of the chief difficulties in the microscopic diagnosis of chorionepithelioma (p. 109).

Clinical Diagnosis.—Cases of chorionepithelioma following quickly upon an abortion have been frequently mistaken for sapræmia with retention of placental tissue, and treated as such. Both conditions are attended with hæmorrhage, a foul uterine discharge, fever, enlargement of the uterus, and the presence within it of decomposing débris of tissue or blood-clot. Clearing out the uterus brings a temporary improvement in cases of chorionepithelioma, but sooner or later the symptoms all recur with severity, and the uterus is again found to contain considerable masses of débris, although completely evacuated at the first operation. The rapid reproduction of decomposing tissue in the uterus under such circumstances is strongly suggestive of chorionepithelioma. The ultimate diagnosis can only be made by a skilled microscopist, and in cases of doubt the whole of the tissue removed from the uterus should immediately be placed in normal saline solution and sent to the pathologist with as little delay as possible.

Treatment.—Hysterectomy is the only treatment which offers any chance of success. Cases have been recorded in which this operation has been successful even after the formation of definite metastases in distant parts. It should, therefore, be advised in all cases, however advanced, if there is a reasonable chance of the patient surviving the operative procedure.

Reproductive Insanity

Insanity may occur in association with all stages of the reproductive process; it is usual to describe as separate conditions the insanity of *pregnancy*, the insanity of the *puerperium*, and the insanity of *lactation*. Cases occurring within six weeks of labour are classed as *puerperal*, those occurring later as cases of insanity of *lactation*; this distinction is artificial, for puerperal involution is not completed at the sixth week, and lactation commences on the third day. The term 'reproductive insanity' may conveniently be used to include all three of these varieties.

From the statistics of the Lunacy Commissioners it appears that, among female patients in this country, cases of reproductive insanity form about 7 to 8 per cent. of the whole, the incidence being rather greater in public than in private institutions. From the records of 259 cases of reproductive insanity from the Claybury Asylum recorded by Jones, it appears that 21·6 per cent. occurred during pregnancy, 46·0 per cent. during the early puerperium, and 32·4 per cent. later than the sixth puerperal week. With regard to the causes of reproductive insanity, three points of special interest may be noted: (1) about 25 per cent. of all cases are said to occur in single women, and in cases of insanity during pregnancy this preponderance is even greater; (2) in a considerable proportion of cases occurring during the puerperium signs of septic infection are present, and it is possible that the toxic condition of the blood thus induced may determine the outbreak in patients subject to hereditary or other predispositions to mental instability; (3) the subjects of insanity occurring in connection with lactation are usually debilitated in health by previous child-bearing or by general causes. To these causes must be added in all cases the general personal and hereditary conditions which favour the occurrence of insanity. According to Clouston, the frequency of puerperal and lactational insanity is about 1 to every 400 confinements.

Insanity in pregnancy and in connection with lactation is usually of the depressed melancholic type, and is associated with tendencies to suicide or infanticide; that occurring in the puerperium is more often of the exalted, maniacal, type. In pregnancy, 80 per cent. of the cases occur after the fifth month; in the puerperium, according to Rigden, over 90 per cent. occur during the first fourteen days; in lactation cases occur with almost equal frequency from the second month to the end of the second year. In puerperal cases the most important premonitory symptom is sleeplessness, which is almost invariably met with; when associated with headache and slight fever it is of still greater significance. The onset of the disease is often an acute outbreak of mania, associated with great violence and restlessness. Depressed types of insanity, however, may also occur in the puerperium.

The prognosis of reproductive insanity is better than that of any other variety of insanity; from 70 to 80 per cent. of all cases are said to recover. The premonitory sleeplessness and headache are best treated by large doses of alcohol and by hypnotic drugs. When the disease fully manifests itself, the patient should be immediately removed to an institution for treatment.

Sudden Death in the Puerperium

Cases of sudden death in the puerperium may be due to *syncope, coma*, or *pulmonary embolism.*

Syncope is, of course, most likely to occur in subjects of chronic cardiac disease (either valvular or myocardiac), in cases of profound chronic anæmia, and in cases where profuse hæmorrhage has accompanied labour or followed delivery. It is well recognised that in cases of mitral stenosis or incompetence the danger is by no means over when the child is born; in a considerable proportion of cases which terminate fatally cardiac failure occurs in the first week of the puerperium. In some rare instances shock appears to be the cause of the syncope, and sudden death has been known to follow rapid emptying of the uterus, as in precipitate labour, in apparently healthy persons.

Syncope can only be treated by cardiac stimulation and the administration of oxygen.

Pulmonary embolism may occur during pregnancy, labour, or the puerperium. It may be caused by detachment of a portion of clot from a healthy thrombosed uterine sinus by violent coughing, by muscular exertion or during a convulsion; sometimes it appears to be spontaneous. Pulmonary emboli of this kind may contain a portion of a chorionic villus which has entered a uterine sinus and been carried thence to the lungs. Occasionally air embolism is caused by the injection of air into the uterus; this has followed puerperal intra-uterine douching, or intra-uterine injections of glycerin for induction of premature labour, when these procedures have been clumsily carried out and air pumped into the uterus. Lastly, pulmonary embolism may occur in cases of phlegmasia dolens by detachment of a portion of the femoral thrombus.

Pulmonary embolism may cause instant death, but this is rare. Usually some hours elapse during which certain symptoms develop which vary according to the size of the obstructed vessel. If this is large, extreme air-hunger (dyspnœa), with cyanosis, and a rapid feeble pulse are the chief symptoms; if the vessel is small, the symptoms resemble those of shock—pallor, cold surface, and small feeble pulse. Recovery is not impossible in the latter case, although naturally the prognosis is very grave.

The only treatment possible is cardiac stimulation and administration of oxygen.

Puerperal coma may occur in the subjects of diabetes, in connection with eclampsia, or from cerebral hæmorrhage.

PART VI

THE NEW-BORN CHILD

General Management

When the child has been delivered in a healthy condition the respiratory process is commenced almost instantly, and after a few ineffectual gasps it cries lustily. The mouth and throat should be immediately cleared out by laying the child on its side and wiping out the buccal cavity and pharynx with a piece of wet cotton-wool twisted round the little finger. Delay in breathing on the child's part may be overcome by lightly flicking or slapping its body, or sprinkling tepid water on its face and chest. When breathing has been started, the eyes should be wiped with boric lotion (1–40) to free the lids from vernix caseosa, &c.; if a purulent vaginal discharge has been present during pregnancy, a solution of 1-4,000 perchloride of mercury should be used for this purpose, and afterwards one or two minims of a 1 per cent. solution of nitrate of silver introduced into the lower eyelid with a dropper; this procedure, introduced by Credé, is a reliable prophylactic against ophthalmia neonatorum. The cord may be divided as soon as it has ceased pulsating, or earlier when respiration has been satisfactorily established. Two ligatures of twisted thread or tape, previously boiled, should be applied, one about an inch and a-half from the navel, the other an inch further away; that on the fœtal side must be tightly tied with care, and the cord then divided with a pair of sterilised (boiled) scissors. Careful antiseptic precautions are required in ligaturing and dividing the cord on account of the danger of umbilical sepsis (see p. 471).

The infant's bath is usually undertaken by the nurse, but the medical man must see that the work is properly done.

The amount of vernix caseosa varies greatly; when there is a good deal it can best be removed by the use of warm olive oil and swabs of cotton-wool. Unless all vernix is removed from the folds of skin at the groins and axillæ, cutaneous irritation will afterwards be caused. The infant may then be placed in a bath of soap and water at a temperature of 100° F. The medical man must afterwards examine the child's body and make sure that no congenital defect is present, such as cleft palate (which would hinder suckling), hernia, undescended testicle, or imperforate anus; the immediate recognition of the latter defect is a very important matter, both for the credit of the doctor and the chances of survival of the child. In the case of a difficult labour, the possibility of obstetric injuries to the head or limbs must be borne in mind. The position of the *caput* in head presentations may be noted for confirmation of the clinical diagnosis of position (see p. 217). The stump of the cord should then be examined to make sure that the ligature is secure, and a sterilised dressing applied so as to envelop it; or the cord may first be dusted over with powdered boric acid, and then enclosed in boric lint. The scorched linen rag which is popularly employed in many parts of the country for this purpose is a very fair approach to a sterilised dressing. The nurse must take the greatest care to keep the cord surgically clean during the process of shedding. The child should, if possible, be weighed before being dressed, and it is well to keep a regular record of its temperature, taken in the rectum.

During the first twenty-four hours the infant sleeps almost continuously, passes a little clear colourless urine, and usually commences the evacuation of its meconium. If it is to be suckled by the mother, the child should be put to the breast once or twice during the course of the first day; a little secretion will be obtained which will suffice for its immediate needs, and is believed to act as a purgative, thus promoting the expulsion of the meconium.

Infant Feeding

The proper food for the new-born child is its mother's milk; unless definite and valid reasons exist for feeding it in some other manner, every child should be suckled by its mother for the first three to six months of its life. This is best for the infant because it is receiving a natural food suited to its special requirements, and best for the mother because a period of mammary activity is a valuable aid to the processes of involution in the genital tract.

Contra-indications for Suckling.—These may be briefly stated, and require little or no comment:

General. (1) Pulmonary tuberculosis in all stages.
(2) Valvular lesions of the heart with incomplete compensation.
(3) Syphilis acquired during pregnancy.
(4) Acute illness of any kind.

Local. (1) Severe fissures of the nipple.
(2) Acute mastitis, with or without suppuration.
(3) Absence of secretion.
(4) Incurable retraction of the nipple.

Infantile. (1) Inability to suck.
(2) Digestive disturbances.
(3) Loss of, or failure to gain, weight.

Composition and Characters of Human Milk.—The reaction of human milk is alkaline, but on exposure to the air it rapidly changes by lactic acid fermentation, becoming first neutral and finally acid. Its specific gravity varies between 1030 and 1034, and it contains about 88 per cent. of water. In solution are found sugar (lactose), certain nitrogenous substances (casein and a small proportion of lactalbumen or whey proteid), inorganic salts (chloride of sodium, phosphates of lime, sodium, potassium, and magnesium), and traces of free gases (carbonic acid, oxygen, nitrogen). These various constituents are constantly present, but their proportions vary at different periods of the puerperium; the following table has been compiled by Cameron and Söldner from a recent series of observations, and their results have been generally confirmed by others:

Period	Proteids	Fat	Sugar	Mineral Salts
1st week .	2·0 %	2·8 %	5·4 %	0·34 %
2nd „ .	1·6 %	3·1 %	6·2 %	0·27 %
4th „ .	1·1 %	3·8 %	6·4 %	0·22 %
3rd month .	1·0 %	2·9 %	6·7 %	0·20 %

An analysis of 94 samples of human milk by Carter and Richmond, taken at varying periods of the first month of the puerperium, gives the following arithmetical mean :

Specific gravity	1031 to 1030
Water	88·04
Proteid	1·97
Fat	3·07
Sugar	6·59
Ash (salts)	0·26

It will thus be seen that the secretion of the first week contains the largest proportion of proteids and salts; after this period the proportions of these constituents steadily diminish. Fat is found to increase up to the end of the first month, and then to fall considerably; sugar steadily increases in proportion to the end of the third month. The average ratio of proteids to carbohydrates (sugar and fat combined) is 1 to 3½. Human milk is to be regarded as a food of somewhat variable composition, and it is probable that a corresponding variation exists in the nutritional requirements or the digestive capacities of infants. The mammary secretion of a multipara is believed to be less variable in amount and constitution than that of a primipara. Variation in the proportion of proteid, fat, and sugar in human milk appears to exert little influence upon the progress of the child.

The daily amount secreted by the mammary glands is estimated at from 1,000 to 1,200 grammes. The presence of micro-organisms in the milk of healthy women has been already mentioned (p. 438).

Diet is an important factor in maintaining the process of lactation ; food rich in proteids and carbohydrates, but simple in form, and accompanied by a liberal allowance of fluid, is best for a nursing woman. In such a diet milk will obviously form an important item. Alcohol is not necessary. Fruit and green vegetables must be taken with caution, as they frequently affect the milk so as to cause digestive disturbances in the child. The greater number of purgative drugs also find their way into the lacteal secretion and act upon the child, castor oil being the chief exception. The quality of the lacteal secretion may be injuriously affected by nervous shock, emotion, fits of anger, hysteria, and other nervous disturbances, but we have no precise knowledge of the nature of the changes which occur in it. From this it follows that women of a pronounced neurotic temperament do not make good nurses. When menstruation occurs in nursing women, the monthly period is accompanied by a diminution in the total amount of the mammary secretion and an increase in the proportion of solids. The effect of pregnancy is variable, and often no influence at all appears to be exerted by it on the mammary function.

Growth and Progress of the Child.—The only true test of successful feeding is the condition of the child. It must be recollected that sometimes a child does not thrive upon its mother's milk even when the mother is healthy and the mammary secretion abundant and apparently normal. During the first three days it loses weight owing to the evacuation of the meconium and to loss of fluid through the kidneys and the lungs; this loss seldom exceeds five or six ounces, but in the child of a primipara loss of weight may continue up to the fifth or sixth day owing to tardy establishment of full mammary activity. At the end of the first week the loss ought to have been made up and the weight at birth regained, but it is not uncommon for progress to be slower than this. During the remainder of the first month a gain of four to seven ounces a week is satisfactory.

About the third or fourth day the character of the infant's motions begins to alter; the meconium disappears, and fæcal matter, yellow in colour, alkaline in reaction, and of the consistence of custard, takes its place. Three or four motions are usually passed daily. Digestive disturbances immediately affect their character (see p. 460). The umbilical cord should undergo dry aseptic necrosis; a line of demarcation forms at its junction with the abdominal wall, and about the fifth or sixth day (see figs. 213 and 222) it separates spontaneously, leaving a small clean ulcer, which cicatrises rapidly. It is, however, not very uncommon for the cord to undergo a moist form of necrosis without offensive odour, and under these circumstances separation may be delayed until the second or even the third week. A cord in this condition must be treated with the most scrupulous care, and kept covered with boric acid, or some non-irritating antiseptic such as aristol. The skin of a healthy infant often desquamates during the first week, and may become yellowish in colour, suggesting jaundice;

this is due to absorption of pigment into the blood from haemolytic changes occurring in the liver.

When suckling by the mother is impracticable from the first, or has to be prematurely abandoned, the infant may be brought up by *artificial feeding* or by a *wet-nurse*.

Artificial Feeding.—Two substitutes for human milk may be employed—viz. the milk of the cow and the ass; the comparative composition of these three is shown in the following table (Rotch)

—	Human Milk	Cow's Milk	Ass's Milk
Sp. G.	1028 to 34	1032	1030
Proteid	[illegible]	3·5 %	2·2 %
Fat	[illegible]	4·0 %	1·6 %
Sugar	[illegible]	4·5 %	6·1 %
Salts	[illegible]	0·7 %	0·5 %

During recent years an elaborate study has been made of the composition of cow's milk and the variations which it undergoes. It has been found that, while the average composition is as stated in the table, wide variations occur in the milk of different kinds of cows, and also in the milk of any single animal from day to day. By using the mixed milk of a herd, greater uniformity of composition can be obtained than with the milk of a single animal. This is directly the contrary of what was formerly believed to be the case. We have seen that human milk is also subject to considerable variations in composition: according to Rotch, this is especially the case with the proteids, which may vary from 1·08 per cent. to 4·14 per cent. without producing any ill effect upon the child. It will accordingly be understood that the above table sets forth the average proportions only.

It may be said generally that cow's milk differs from human milk in being acid in reaction, in containing considerably less sugar and considerably more proteid, while the percentage of fat is about the same; further, the proteids of cow's milk differ in being less easily digestible than those of human milk. Milk proteids are of two kinds: *caseinogen* or coagulable proteid—*i.e.* coagulable by the enzyme of rennet and *whey proteids* or non-coagulable proteids—*i.e.*

those which remain in solution after coagulation with rennet. The proportions, according to Koenig, are:

	Human	Cow
Caseinogen	0·59 %	2·88 %
Whey proteid	1·23 %	0·53 %

The practical result of this difference is that the curd of cow's milk is coarser and more difficult to digest than that of human milk.

It must also be borne in mind that cow's milk is liable to contamination with pathogenic organisms, and certain epidemic diseases, such as scarlet fever and diphtheria, or such endemic diseases as tuberculosis, may be propagated by it. And, lastly, cow's milk may become altered by fermentation, so as to set up acute gastro-intestinal irritation in infants. The same result may possibly accrue from the use of such preservatives as boric acid, which are often added to milk in hot weather in order to prevent the occurrence of fermentation.

Ass's milk closely resembles human milk in composition, not only as regards the proportions of its elements, but also, it is believed, in the digestibility of its proteids. The amount of fat is, however, much less than in human milk. The remarks made as to the contamination of cow's milk apply equally to ass's milk. The practical objection to the use of ass's milk is that it cannot be obtained except in large towns, and its cost is prohibitive to all but the rich. Accordingly the staple substitute for human milk is cow's milk.

The preparation of cow's milk for infant feeding is a matter of the highest practical importance; the two important steps are sterilisation, and modification in composition.

Sterilisation.—The simplest way to sterilise milk is to boil it for ten minutes; the boiling-point of milk is 220° F. This destroys all bacteria, including their spores. The objections to boiling are (1) that it impairs the flavour of the milk; (2) that it destroys certain elements, of unknown composition, upon which its antiscorbutic properties depend. Constipation, scurvy, and rickets are believed to be produced by its prolonged use. Boiling is therefore not to be advised. The second method is to place the milk to be sterilised in a water-bath, raise the water to the boiling-point, maintain it at this temperature for twenty minutes, and then remove the vessel containing the milk and allow it to cool. If the milk-containing vessel is only three-fourths immersed in the boiling water the temperature of the milk does not rise much above 180° F. This method is often spoken of as 'sterilisation.' A third method is to employ a water bath in the same manner, but to raise the temperature of the water only to 170°–175° F., and maintain it at that temperature for thirty to forty minutes. The temperature of the milk will be about 160° F. This is often called 'Pasteurisation.' 'Sterilisation,' so-called, destroys practically all germs except the anthrax bacillus, but does not destroy their spores. 'Pasteurisation' produces much the same result, and if repeated two or three times, milk may be rendered absolutely sterile in this manner. It may be recollected that human milk is not sterile, and may even at times contain pathogenic organisms; it is therefore unnecessary to aim at the absolute sterilisation of cow's milk: the destruction of living organisms is probably sufficient. Unknown chemical changes are induced in milk by heat, and it is therefore desirable to employ the method in which the temperature used is the lowest.

It must be recollected that the ill effects of contamination of milk may not be entirely obviated even by these methods, for toxins may be present, and these cannot be destroyed by heat. The securing of a fresh and uncontaminated supply therefore remains a matter of great practical importance.

Modification.—The composition of cow's milk can be approximated to that of human milk in respect of the proportions of the principal ingredients. First the milk is diluted to reduce the percentage of proteids to about one-fourth; this will be done by adding three parts of diluent to one of milk. But this procedure will reduce the proportions of fat and sugar to a point much below their level in human milk; therefore fat in the form of cream, and sugar in the form of lactose, are added to the diluted milk in order to bring up their proportions to the proper level. Thus, if one part of milk is diluted with three parts of water, the proteid in the mixture will be about 1 per cent.; this is a little too low, but as cream contains the same proteids as milk, the addition of cream raises the percentage of proteid to a point which is [illegible]ient. Cream as sold at dairies varies in the percentage of fat which it contains, from 10 per cent. to 20 per cent.; when in the case of delicate children accuracy is desirable, the fat may be estimated at a laboratory. A sufficiently exact 10 per cent. cream can be prepared domestically by allowing a quart of fresh whole milk to stand in a quart measure for six hours: the upper eight ounces will consist of 10 per cent. cream; or, if more exact proportions are desirable, a separated (centrifugalised) standardised cream of 16 per cent. can be obtained from most of the large dairies. By dilution of one to three, the proportion of sugar is reduced to about one-sixth of the required amount. A little is replaced by the added cream; the remainder can be made up with lactose.

Although the proportion of the chief ingredients can be thus adjusted, certain differences will remain—viz. the acid reaction, and the comparatively high percentage of caseinogen (coagulable proteid). The reaction can be adjusted by using lime water as a portion of the diluent; the digestibility of the proteids can be increased by the use of citrate of sodium in doses of one grain to each ounce of the prepared food. This salt possesses the useful property of retarding the coagulation of all forms of albumen.

A modified milk suitable for the first week of infant life may therefore be made up as follows:

Whole milk	5 oz.
Water	13 oz.
Lime water	1½ oz.
Cream (10 %)	2½ drs.
Lactose	2 tablespoonfuls
Citrate of soda	20 grs.

The pint of food thus prepared is sterilised before use by one or other of the methods just described. The most convenient apparatus is that of Soxhlet (fig. 229). During its first week of life the infant requires about ten feeds in twenty-four hours. Into each of the ten bottles provided, sufficient of the feeding mixture is poured to make one feed. All the bottles are simultaneously heated in the water-bath to the temperature desired and their mouths closed with the special rubber cap supplied. They are then removed, and as the contents of the bottles cool the rubber caps become drawn in by atmospheric pressure, rendering them practically air-tight. Thus the day's supply is prepared without undue trouble.

The amount for each feed during the first week is 1½ ounce. At the beginning of the second week the amount is increased to 2 ounces, and the proportion of milk and diluent to milk 1, diluent 2; the remaining ingredients are unaltered. The feeds should be given every two hours in the day, and every three hours at night, and when the child is four weeks old, 2½ ounces can be given at each feed. The degree of concentration should be gradually raised thus: fourth week, milk 6½, diluent 13½; fifth week, milk 8, diluent 12; sixth week, milk 9, diluent 11; eighth week, milk 10, diluent 10 (in 20 ounces). Whole milk can generally be taken by an infant three months old.

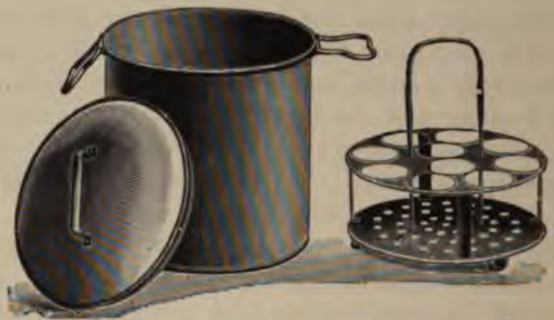

FIG. 229.—SOXHLET'S MILK STERILISER.

A bottle, with a large rubber teat, and without tubing, should be employed; after use, the bottle and the rubber teat should both be boiled for ten minutes, and kept immersed in boric-acid lotion until again required. The infant's mouth should receive the same attention as in breast feeding (p. 404).

Healthy infants with normal digestive capacity almost invariably thrive upon this method of feeding. Delicate infants are sometimes unable properly to digest cow's milk, and some further modification is then required. The common signs that the food is unsuitable are (1) restlessness and crying after feeding; (2) looseness of the bowels or diarrhœa; (3) acid fermentation of the stools, accompanied by green colour; (4) presence of fragments of undigested curd in the stools; (5) failure to gain, or loss of, weight. Under such circumstances cow's milk diluted and modified in the manner above described, and then peptonised for periods varying from ten to thirty minutes, may be used. This preparation is easily digested; however, infants gain in weight but slowly upon it, and its use for prolonged periods is undesirable. A very useful substitute for milk may be found in a mixture of whey and cream, usually called the 'whey-cream mixture.' Whey differs from whole milk in being almost entirely free from the coagulable proteids, and in containing but a small percentage of fat. The composition of whey, according to Koenig, is as follows:

Proteid	0·86 %
Fat	0·32 %
Sugar	4·90 %
Salts	0·63 %
Water	93·38 %

The proteid elements which are most difficult to digest having been eliminated, this food is very suitable for premature or delicate infants and may be given in the proportions of whey ℥iss., cream ʒj. for each feed. The mixture must of course be sterilised.

In America a system of modifying cow's milk by laboratory processes so that the various ingredients may be combined in any required proportions (*humanised milk*) has been widely adopted, and it is customary for the physician to prescribe the exact composition of the milk he orders, and vary it from week to week as he may think desirable. In this country 'humanised milk' can be obtained in London and the larger provincial towns. If the sanitary condition of the dairy or of the farm from which the milk is obtained is open to suspicion, condensed milk may be used instead of cow's milk; in the first week the dilution should be 1 to 16, rising to 1 to 12 for the remainder of the first month. The addition of sugar is unnecessary.

Mixed Feeding.—When the mammary secretion is insufficient in quantity for the child's needs, but otherwise suitable, artificial feeding should be used in addition, breast and bottle being given alternately, or the one in the daytime, the other at night. Infants thrive well upon this method.

If serious difficulty is experienced in feeding the infant upon cow's milk, and ass's milk is not available, a wet-nurse is the only remaining alternative, and the value of this method of feeding delicate infants cannot be over-estimated. It would be much more widely employed but for the difficulty so frequently experienced of obtaining the services of a suitable nurse.

Wet-nursing.—The selection of a wet-nurse throws a serious responsibility upon the medical man. He must be satisfied that the breasts are secreting freely, the nipples healthy and well-formed, and the genital organs healthy. She should be a multipara with a child of about the same age as the one she is to nurse; she and her child must both be free from any taint of constitutional disease. In addition she must be cleanly in habits and of good moral character. It is therefore necessary for the medical man to make a complete physical examination of the mother and her child before selecting a wet-nurse. It is difficult to obtain the services of women of respectable character as wet-nurses, and in any case the greatest care is required to ensure against frauds which a candidate may easily practise, as, for instance, the substitution of another child for her own. A syphilitic infant must not be brought up by a wet-nurse.

Management of Premature Infants.—Much greater care is required in the management of a seven-months infant than of one at full term, for prematurity implies a low heat production and indifferent digestive activity. Incubation of premature infants has been much employed, but it is doubtful whether this is really necessary, except in the case of infants of not more than three pounds' weight. The incubator generally used in this country (fig. 230) is heated by hot-water bottles, which are placed in a closed chamber under the bed; ventilation is permitted by apertures of entrance which communicate with this chamber, and apertures of exit under the roof; a thermometer fixed to one of the glass walls enables the temperature to be kept under observation. A fairly uniform temperature can be maintained (about 85° to 90° F.), but ventilation is very imperfect, and the infant undoubtedly suffers from want of fresh air. Experience shows that equally good results may be obtained by keeping the child in a warm well-ventilated room (about 70° F.); it should be screened from draughts, and the bed in which it lies can be kept at a temperature of about 100° F. by the use of hot-water bottles rolled up in blankets. The child should not be dressed in the ordinary manner, but wrapped up in sheets of cotton-wool or Gamgee tissue. It should be disturbed as little as possible, and, although bathing is not advisable, the skin may be kept clean by the daily use of olive oil, with which the whole body should be freely smeared; this probably has also a certain nutritive value, some of the fat being absorbed by the skin.

Feeding may present some difficulties. Premature infants weighing four to five pounds can usually take the breast satisfactorily; if not, the breast milk may during the first few days be withdrawn by a breast-pump, and administered with a spoon; this, however, cannot be continued for long. Cow's milk when used must be given more dilute—*i.e.* with a larger proportion of water—than in the case of a full-time child, and the strength must be very cautiously increased. Sodium citrate is particularly useful in assisting the digestion of the caseinogen. Humanised milk or the whey-cream mixture are especially useful in feeding premature infants. The quantity given each time must be small, and during the first week it is best to feed the infant every hour.

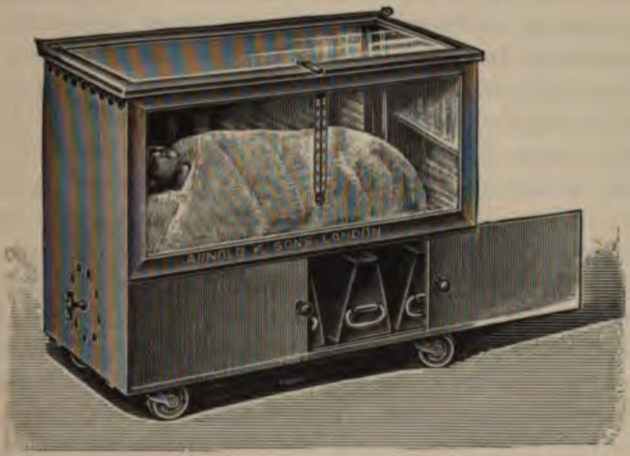

Fig. 230.—Incubator for Premature Infants.

If the child cannot suck through a teat, the food should be dropped gently and slowly into its mouth through a glass pipette. Sometimes premature infants are at first too feeble to swallow, and they must then be fed through a narrow soft rubber catheter passed into the stomach. After the first week the intervals of feeding may be lengthened, and the total amount *per diem* gradually increased.

Digestive Disturbances.—In breast-fed babies digestive disturbances are rare when the mother is healthy, the condition of the mammary glands satisfactory, and the necessary precautions are observed in keeping the nipples and the child's mouth clean. In bottle-fed babies they are much more common, and are due either to the kind of food in use being unsuitable to the child, or from failure to observe the necessary rules of cleanliness already laid down. Digestive disturbances are indicated in infants by abdominal symptoms such as colic, vomiting, constipation, or diarrhœa; by the parasitic eruption known as *thrush*, and by loss of weight or failure to increase in weight. *Colic* is indicated by attacks of violent screaming, in which the legs are drawn up to the abdomen; the attacks are often suddenly relieved by the passage of flatus. *Diarrhœa* is usually accompanied by a greenish discoloration of the stools, the result of an acid fermentation, and frequently they contain fragments of undigested milk curd. It also usually causes redness and irritation of the skin around the anus, which may spread over the buttocks and inner sides of the thighs. *Thrush* is characterised by the appearance of a crop of slightly elevated, circular, white spots in the mouth and throat, and sometimes within and around the anus. They are due to a fungus—*oïdium albicans* which can be readily detected by the microscope in the scrapings from these patches. It is always accompanied by some or all of the symptoms of disturbed digestion. On inquiry, the condition can usually be traced to the use of dirty bottles or teats, or to lack of attention to the child's mouth. Wasting from unsuitable feeding must be distinguished from constitutional conditions such as syphilis.

Digestive disturbances are to be treated not so much by drugs as by regulation of the quantity and quality of the food, and by strict attention to cleanliness. A common error in artificial feeding is giving the food in a too concentrated state: no rule will apply to every case, and increased dilution may often be advisable even when the food is apparently not too concentrated. Barley water or rice water may be used instead of plain water for diluting the milk in digestive disturbances. If the child does not thrive on cow's milk prepared in the manner described, a wet-nurse or a supply of "humanised" milk or of ass's milk should be obtained instead. Constipation can often be relieved by a slight alteration in the food: increased dilution or the addition of an excess of cream will often suffice. Drugs should be avoided, but ʒj. of olive oil may be given occasionally when required. Diarrhœa is best treated by a single dose of a mixture of castor oil ʒss., with olive oil ʒiss., followed by a change of feeding. The poor often administer starchy food to very young infants; this is quite unsuitable, for the amylolytic digestive ferments are undeveloped in the infant. Another common error is the use of artificially prepared patent foods for infants; these are all deficient in fat, which is one of the most useful and most easily digested elements of an infant's food, and wasting is accordingly very apt to occur. Thrush needs no special treatment beyond the cleansing of the mouth with boroglyceride, and attention to the food and to the condition of the bottles and teats.

Acute gastro-enteritis may result from persistence in unsuitable feeding, or from infection of the alimentary canal by contaminated milk. It is almost unknown in breast-fed babies. It is one of the most serious disorders of early infancy, and is attended by a high mortality. The chief symptoms are persistent vomiting and diarrhœa, with collapse, indicated by coldness and cyanosis of the face and limbs. There is usually great irritation and some excoriation of the skin of the buttocks, and general cutaneous eruptions of different types and distribution are often present. The treatment is, in the first place, to stop the administration of food entirely for twenty-four to forty-eight hours, or to give the infant only plain water or albumen-water in small quantities. Then a wet-nurse should be obtained, if this is practicable; if not, the whey-cream mixture may be cautiously given or well-diluted peptonised cow's milk. The question of food is all-important, drugs being of little use.

Obstetric Injuries and Diseases of the Fœtus

Asphyxia Neonatorum (Still-birth).—Asphyxia, which literally means *pulselessness*, has come by usage to mean interruption of the respiratory function, and is now used in this sense only. Asphyxia in the new-born child may arise *in utero* from complications of labour, in which case the child is born asphyxiated (intra-uterine suffocation); or it may arise from failure to establish pulmonary respiration when born, in which case the asphyxia comes on after delivery. The latter is very rare, the former is common.

Respiration as it is found in the fœtus *in utero* consists in a gaseous exchange between the fœtal blood and the maternal blood effected through the placenta. Therefore anything which causes interruption, partial or complete, of the placental circulation, either fœtal—through the villi, or maternal—through the inter-villous spaces, will tend to induce intra-uterine asphyxia. The following conditions may accordingly cause it: (*a*) *Premature detachment of the placenta* (ante-partum hæmorrhage). (*b*) *Compression of the cord* (cord prolapsed, or tightly coiled round the fœtus, or caught by the after-coming head). (*c*) *Tonic uterine contraction*, causing continuous compression of the placenta. These conditions may all be complicated by *blocking of the fœtal air-passages with fluids from premature respiration in utero*, due either to cutaneous stimulation (breech cases), or to partial interference with the placental circulation, which, by causing accumulation of carbonic acid in the blood, stimulates the respiratory centre before paralysing it.

Failure to establish the pulmonary respiratory function after birth may be due to (*a*) *head-injuries* causing interference with the action of the respiratory or vaso-motor centres in the medulla; and (*b*) such *congenital defects* as stenosis of the trachea or the pulmonary artery. Obviously cases may be met with in which the causation is complex—*e.g.* blocking of the air-passages with fluids may be associated with injury to the head received in difficult labour.

The asphyxial phenomena in new-born infants will depend in the main upon the extent and duration of the interference with the placental circulation which has preceded delivery. The commencement of the process of asphyxia is characterised by cyanosis and high blood-pressure: this phase is commonly known as *cyanotic* or *blue asphyxia*. Later on the blood-pressure is reduced, the circulation fails, and the skin becomes pale; this phase is called *pallid* or *white asphyxia*, and is, of course, more serious than the former.

Cyanotic Form.—This form of asphyxia is characterised by the deep blue or purple tint of the skin, and by other appearances suggestive of suffocation—viz. half-opened eyelids and injected conjunctivæ; there is also slight muscular rigidity of the limbs, with preservation of the cutaneous reflexes. The heart usually beats vigorously, and its movements can be readily seen and felt through the chest-wall; sometimes in more severe cases only feeble cardiac movements can be detected.

Pallid Form.—In this form the skin is blanched, the limbs are flaccid from complete loss of muscular tone, the eyes closed, the pupils dilated, the umbilical cord almost pulseless, and the cardiac movements feeble; they may be unrecognisable except by the stethoscope. All the reflexes—superficial and deep—are lost, the sphincters often being relaxed so that urine and meconium escape.

In both forms the child makes no voluntary movements; hence the time-honoured name of *still-birth* applied to the condition.

The probability of the child being born in a condition of asphyxia may be sometimes foretold during labour; thus direct evidence of *fœtal distress* may be afforded by slowing and enfeeblement of the fœtal heart-sounds, or by the passage of meconium in cases other than breech presentations. In breech presentations, and cases of ante-partum hæmorrhage, there is always an increased risk of still-birth. Accordingly, under all such circumstances, preparations for resuscitation should be made before delivery.

Treatment.—The first step is to clear the mouth and throat of fluids; this may be done by laying the child on its side and wiping the throat out with pledgets of wet cotton-wool; or by inverting it for a moment or two so as to allow retained fluid to escape from the throat. In a case of cyanotic asphyxia attention may then be solely directed to exciting the respiratory centre; in a case of pallid asphyxia cardiac is quite as important as respiratory stimulation. The treatment of the two conditions is accordingly somewhat different.

In *cyanotic* asphyxia, when the heart beats strongly, vigorous measures may be adopted, such as sprinkling the chest with cold water, flicking the trunk with a towel dipped in cold water, or momentarily immersing the trunk and limbs of the child in tepid and warm baths alternately (temperature about 60° and 105° F.); or, while in a warm bath, cold water may be sprinkled over its head. As the cutaneous reflexes are preserved, these measures usually produce a considerable effect upon the respiratory centre. If they fail to excite any response, artificial respiration must be at once employed. When, in this form, the cardiac pulsations are feeble at the outset, artificial respiration should be begun as soon as the throat has been cleared.

In *pallid* asphyxia the greatest care must be taken to preserve the body-heat, and to maintain the circulation. A useful method is to immerse the infant's body in a warm bath (105° F.) for several minutes, holding its head clear, gentle friction being used meanwhile to the trunk and limbs; by gently compressing the base of the chest between the hands, and then allowing the chest-wall to recoil, artificial respiration may be practised at the same time. Or the child may be laid over a hot-water bottle well protected with blankets, and a rectal injection of ℥j. to ℥ij. of warm saline solution may be administered. Cutaneous stimulation of the respiratory centre is impracticable, as the cutaneous reflexes are lost, and accordingly artificial respiration should be begun with as little delay as possible.

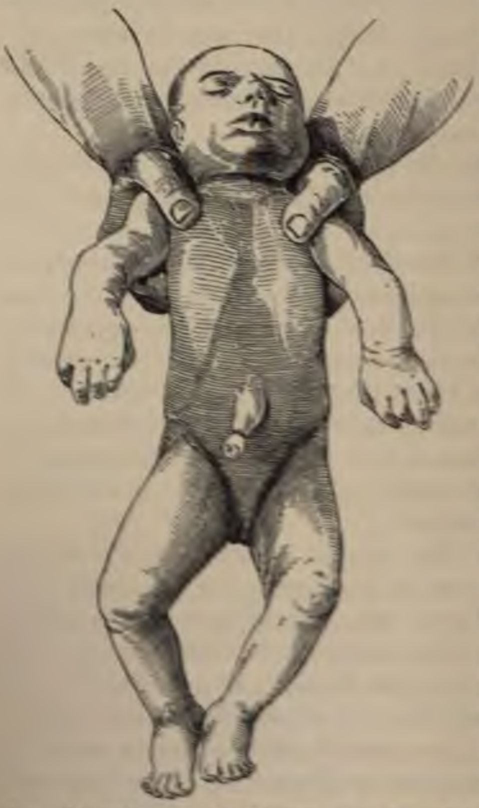
FIG. 231.—SCHULTZE'S METHOD OF ARTIFICIAL RESPIRATION: FIRST OR INSPIRATORY POSITION.

Methods of Artificial Respiration.—While many may be practised upon the adult, only three are of practical importance in the case of the new-born child.

(1) *Schultze's Method.*—The body of the child is held by the shoulders, the thumbs passing over the clavicles, the fingers supporting the back; the ulnar margins of the hands are sufficiently separated to allow the head to lie between them in a position midway between flexion and extension, so as to allow free passage of air through the glottis. This is the *first* or *inspiratory position* (fig. 231): the lower limbs hang down, so that the trunk is extended; in this attitude the diaphragm is drawn down to the lowest possible level, and air is thus drawn into the lungs. The body of the child is then swung lightly into the position shown in fig. 232; this is the *second* or *expiratory position*. The trunk is now flexed, and the weight of the lower limbs and the abdominal viscera is thrown upon the diaphragm, causing it to ascend and expel air from the lungs. Next the body of the child is allowed to fall back gently into the first position. The head must be held steady by the wrists during these movements, and not allowed to fall forwards against the chest, or the passage of air through the glottis will be impeded. The movements should be regulated so as to produce about fourteen to twenty respirations a minute. The reversed position of the trunk in the expiratory movement is also useful in promoting the escape of fluid from the air-passages. When the body is thickly covered with vernix a handkerchief or towel must be used to hold it securely.

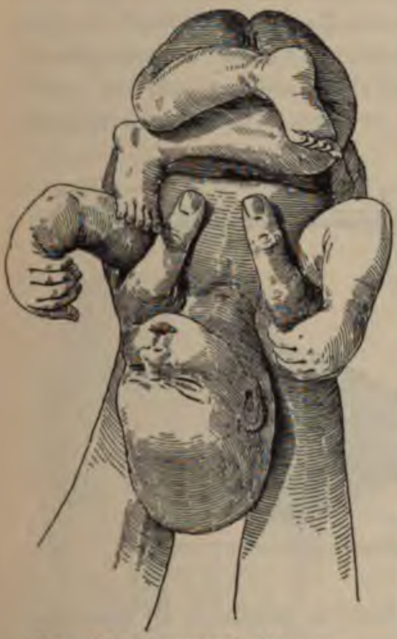

FIG. 232.—SCHULTZE'S METHOD: SECOND OR EXPIRATORY POSITION.

(2) *Sylvester's Method.*—The child's body is laid on its back upon a pillow, the head being allowed to hang over the end in a position midway between flexion and extension. If

necessary the body may be kept warm by placing it on a hot-water bottle well protected in a blanket. The tongue should be pulled out with the corner of a handkerchief, and an assistant is required to hold the feet steady. The arms are then seized by the elbows and pressed gently but firmly against the chest-wall (expiration); next the arms are carried round by an upward and outward sweep until they lie at the sides of the head (inspiration). These movements are made at about the same rate as in the former method.

(3) *Insufflation.*—This method is only required when the air-passages have become waterlogged by premature respiration *in utero*; great difficulty may then be experienced in causing air to enter the lungs by the methods of artificial respiration just described. Insufflation may be practised by the mouth-to-mouth method, or by catheterisation of the trachea. The former is not to be advised, for the greater part of the air blown into the mouth passes down the œsophagus into the stomach instead of through the glottis. When insufflation is indicated the latter method should be adopted. An ordinary gum-elastic catheter is the only instrument required; in introducing it the index finger of the right hand should be passed into the throat, over the epiglottis, and the catheter directed along its palmar surface into the larynx. When carefully introduced no injury will be caused to the soft parts by the catheter. Air may be now gently blown into the trachea, and if fluid is present this will bubble up at the sides of the catheter into the mouth, and can be wiped away.

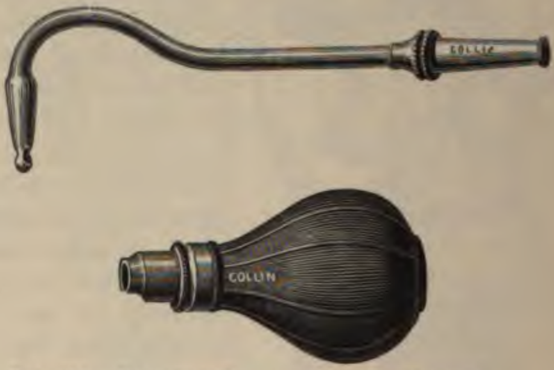

FIG. 233.—RIBEMONT-DESSAIGNES'S INSUFFLATOR.

When most of the fluid seems to have been expelled, Sylvester's method of artificial respiration should be resorted to, with the catheter left in position. Used in this manner for merely freeing the air-passages, insufflation is useful. As a method of artificial respiration it is unsatisfactory, first because of the risk of rupturing the pulmonary vesicles and causing emphysema by blowing air too vigorously into them; and secondly, because the air thus introduced into the child's lungs is exhausted air, loaded with various impurities, and consequently unsuitable for resuscitation. Ribemont-Dessaignes has invented an insufflator by means of which atmospheric air can be blown directly into the trachea, thus neutralising the latter objection (fig. 233).

Schultze's method is not so well suited as Sylvester's to cases of pallid asphyxia on account of the handling and exposure of the child which it entails. While performing artificial respiration, care should be taken not to interfere with the first irregular spontaneous attempts to breathe which the child may make. At first, long intervals occur between these attempts, during which artificial respiration must be resumed. The condition of the heart must be carefully watched. As long as cardiac pulsations can be made out with the stethoscope there is a chance of success; when these have definitely ceased the child, of course, is dead. After it has been successfully resuscitated the child often remains very feeble, and may die in two or three days from cerebral injury or from pneumonia—*e.g.* if fluids have been drawn into the air-passages. The prognosis after successful resuscitation is much less favourable with the pallid than with the cyanotic form of asphyxia.

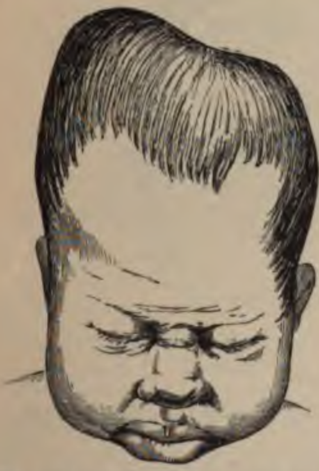

FIG. 234.—DOUBLE CEPHALHÆMATOMA. (RIBEMONT-DESSAIGNES AND LEPAGE.)

Injuries to the Head.—*Cephalhæmatoma.*—This condition consists in an effusion of blood beneath the pericranium, due to detachment of this membrane during labour. Usually the effusion takes place gradually, and the swelling may not appear for a day or two after birth; but it may be found on the head at birth. The cause of the separation of the periosteum is unknown; the bone is very seldom injured, and, though usually occurring after a difficult labour, it is occasionally seen after a normal and easy delivery.

The usual situation is upon one or other parietal bone; sometimes it is bilateral, affecting both parietal bones (fig. 234); more rarely multiple cephalhæmatomas are met with. The swelling varies a good deal in size: it may be no larger than a walnut, when the area of detached periosteum is small; it may, however, attain the large size shown in fig. 234. It is limited by the sutures to the area of the affected bone—*i.e.* it never spreads beyond them, because at the sutures dura mater and pericranium are united. At first it is soft and fluctuating, but soon a dense hard edge forms around it, due to osteoplastic changes at the margins of the effusion. The blood remains fluid in the centre and is gradually absorbed, but several months may elapse before it entirely disappears. No treatment is necessary; incision or puncture is inadvisable.

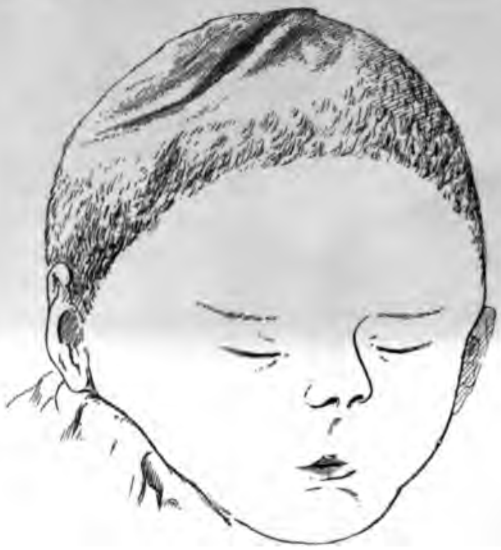

FIG. 235.—SPOON-SHAPED INDENTATION OF THE RIGHT PARIETAL BONE.

Indentation of the Bones.—This injury results from the pressure of the sacral promontory upon the part of the head with which it is in contact. It therefore usually occurs upon the parietal bone, and is often found after labour in a flat pelvis. The indentation or depression is usually oval and spoon-shaped, and the depression is deep at one end of the oval and gradually rises to the level of the general surface of the head at the other (fig. 235). The spoon shape is probably produced by the transverse gliding movement described on page 299, the deep end of the depression being posterior, the shallow one anterior. Similar indentations may be found sometimes upon the side of the frontal bone. No treatment is required as a rule, for the bone gradually rises into its proper position; if this does not occur, an operation to elevate it can be practised.

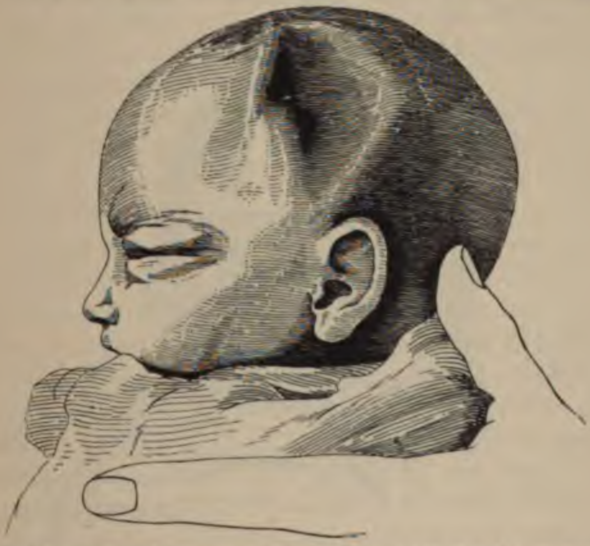

FIG. 236.—DEPRESSED FRACTURE OF THE LEFT PARIETAL BONE CAUSED BY LABOUR IN A FLAT PELVIS. (BUMM.)

Fracture of the Skull.—This injury is almost always due to difficulty in delivering the head by forceps or version; but it may sometimes occur after spontaneous delivery in cases of contracted (flat) pelvis. The posterior parietal bone is the one most commonly injured, as it is compressed by the sacral promontory. Fracture may be complete or incomplete; often it is depressed (fig. 236) and associated with meningeal hæmorrhage.

Cerebral Hæmorrhage.—This may be extra-dural, sub-arachnoid, or ventricular, but exact diagnosis during life is not easy. Difficult labour is invariably the immediate cause, but premature infants are much more liable to this form of injury than mature infants. A child with well-marked cerebral hæmorrhage is usually still-born; even if it is possible to resuscitate it, general convulsions, or local clonic spasms or contractures, soon occur, and death follows. Sometimes no abnormality is detected until the second or third day, when trismus, dysphagia, or convulsions supervene, ending in death; such cases are of course due to slowly progressive hæmorrhage.

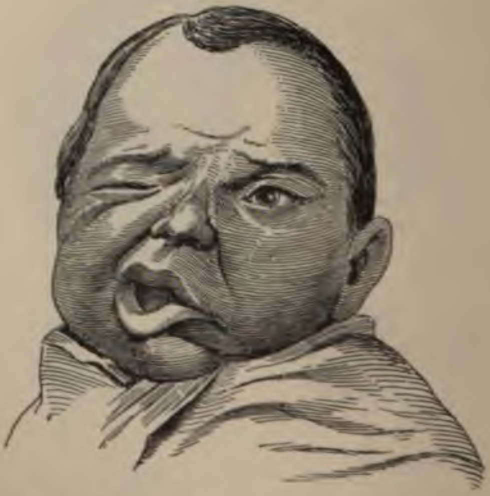

FIG. 237.—FACIAL PARALYSIS IN THE NEW-BORN CHILD. (BUDIN.)

Birth Paralyses.—*Facial Paralysis.*—This injury is usually caused by forceps delivery, and is due to compression of the facial nerve in the parotid region by the blade. A few cases have, however, been observed after spontaneous delivery, but their causation is quite obscure. The resulting deformity is characteristic (fig. 237). As a rule, the nerve recovers spontaneously in a day or two; but severe cases may be met with in which a certain amount of paralysis persists, and local electrical treatment will then be necessary.

Paralysis of the Arm.—The mechanism of this form of paralysis (generally known as Duchenne's palsy) is not well understood, but the immediate cause is injury to the brachial plexus or the nerve roots which supply it. Difficulty in labour is almost invariably associated with it, but some cases have been recorded after spontaneous labour. The muscles most commonly affected are the deltoid, biceps, coraco-brachialis, and supinator longus—*i.e.* the muscles supplied by branches from the fifth and sixth cervical nerves.

Fractures of Limbs result from unskilful delivery; they may occur in breech presentations, from difficulty in freeing extended arms; or in head presentations when there is difficulty in disengaging the shoulders.

Umbilical Sepsis.—Septic infection through the navel may occur when the cord is divided, during the process of separation or subsequently. Some authorities consider that it is a frequent occurrence, and is responsible in one form or another for about 10 per cent. of the mortality among infants under one month old. This opinion is based mainly upon the results of autopsies, which frequently show internal evidences of sepsis in cases in which its existence was not suspected during life. Local signs of septic infection of the navel may be seen in erysipelatous inflammation of the skin, sloughing or suppuration at the line of demarcation, often accompanied by hæmorrhage, or a sloughing condition of the ulcer left when the cord has come away. In addition to these obvious local appearances, septic arteritis and phlebitis may occur, which spread rapidly up the abdominal portion of the umbilical vessels without giving rise to noticeable external changes. Such cases usually terminate in general dissemination of the septic process by embolism. In tetanus neonatorum, a very rare affection, the organisms probably enter at the navel.

The only effective treatment is prophylactic; it has been suggested that the cord should in routine practice be amputated close to the abdominal wall, and the skin edges united by stitches at birth. This is unnecessary if the cord is treated systematically with proper surgical cleanliness. The infant should be sponged, not bathed, until the cord has separated and the umbilicus has healed.

Ophthalmia Neonatorum.—This condition begins as an acute purulent conjunctivitis, but may go on to attack the cornea, when it may result in partial or total permanent blindness; or complete disorganisation of the eyeball from perforation of the cornea may occur. From observations made by Sikes at Queen Charlotte's Hospital there is reason to believe that the conjunctival sac of the new-born child, while not absolutely sterile, does not contain pathogenic organisms under healthy conditions. Ophthalmia is therefore due to infection; in very rare instances this may occur *in utero* from infection of the amniotic fluid, for such cases have been recorded; in the great majority, however, the infection occurs during or immediately after labour; in a smaller but quite definite proportion it occurs in the first few days of extra-uterine life. It is probable that infection occurring immediately after birth is due to particles of discharge which cling to the eyelids or eyelashes, and gain access to the conjunctival sac when the eyes are first opened. In about 60 per cent. of cases the infection can be proved to be gonorrhœal by the discovery of gonococci in the pus; in the remainder various organisms have been found, including bacterium coli, pneumococcus, Klebs-Löffler's bacillus, and the pyogenic micrococci. Gonorrhœal cases occur by direct infection from the mother; in normal labour the eyelids are tightly closed and probably water-tight during the birth of the head, but in face presentations or in delivering the after-coming head the eyes may be infected by the examining finger. Other organisms, not derived from pre-existing disease of the maternal passages, no doubt obtain access in the same manner. A certain proportion of the non-gonorrhœal cases are probably of a simple catarrhal nature and due to cold. Complications such as keratitis are very much rarer in non-gonorrhœal than in gonorrhœal cases.

The signs of ophthalmia make their appearance during the first four days of life in from 50 to 80 per cent. of all cases; very few cases arise later than the first week. Gonorrhœal cases begin earlier than other kinds, because infection is early, and possibly because the period of incubation of the gonococcus is short. The conjunctivæ become greatly injected and excrete a free purulent discharge; the eyelids become reddened and œdematous, and, from spasm of the orbicularis palpebrarum, distension of the conjunctival sac with pus occurs. On gently separating the eyelids, the discharge will escape in large quantities. Usually both eyes are affected, either simultaneously or consecutively; when one eye at first escapes it is difficult to preserve it from subsequent infection.

Treatment. — Ophthalmia has been almost entirely banished from lying-in hospitals by the routine employment of prophylactic treatment. This consists in bathing the eyelids immediately after the head has escaped from the vulva with an antiseptic lotion such as 1–4,000 perchloride of mercury, and the subsequent instillation into the conjunctival sac of one or two drops of a 1 per cent. solution of nitrate of silver. The efficacy of silver salts in destroying the gonococcus is well known, and their employment in this connection is of course a prophylactic for this organism only. A 20 per cent. solution of protargol, a vegetable salt of silver, may be substituted for the solution of the nitrate. Some disadvantages attend the instillation of silver nitrate—viz. a certain amount of conjunctivitis is often set up by the solution, even when there has been no infection, and occasionally keratitis ensues, which may lead to corneal opacities. However desirable it may be in hospital practice, routine anti-gonorrhœal prophylaxis is certainly unnecessary in private practice, but it would of course be indicated by direct evidence, or by suspicion of gonorrhœa in the mother.

Active treatment consists chiefly in frequently irrigating the conjunctival sacs with warm saturated boric lotion, and the instillation once a day of silver nitrate or protargol solution. The highly infectious nature of the discharge must be borne in mind, and the child must accordingly be put in the charge of a separate nurse, to whom the risk both to herself and others should be fully explained. In severe cases the advice of an ophthalmic surgeon should be obtained.

Icterus Neonatorum.—Jaundice occurs in the new-born child under three different conditions: first it may be due to the normal hæmolytic changes which occur in the liver and other organs; secondly, it may be due to congenital stenosis of the bile-ducts; thirdly, it may be infective and due to umbilical sepsis or some form of intestinal intoxication. The first variety is unimportant; it is most marked in premature or debilitated infants, and disappears spontaneously without treatment; the urine does not contain bile acids or salts, nor are the stools decolorised. The second and third varieties are almost necessarily fatal; the third is sometimes epidemic in character.

Infantile Syphilis. — The early recognition of infantile syphilis is of such importance that the matter must be briefly referred to; for a systematic account a text-book of Diseases of Children should be consulted. A syphilitic infant is often premature, and even when born at term is usually undersized. The skin is often of a brownish colour, and wrinkled from deficiency of subcutaneous fat; sometimes, however, the child appears to be quite healthy when born. In a few days some or all of the following signs may appear: (1) skin-cracks (rhagades) at the corners of the mouth; (2) nasal catarrh (snuffling), which sooner or later is accompanied by a watery discharge; (3) an eruption on the buttocks, at first dull red and later coppery in colour, and tending to spread in a papular form down the legs; (4) loss of weight. It must be remembered that simple nasal catarrh from cold often occurs in infants, therefore snuffling does not necessarily indicate syphilis; and the eruption on the buttocks at first resembles that due to diarrhœa. Any combination of the above conditions justifies careful inquiry for syphilitic taint in the parents. The treatment consists in administering grey powder in doses of half a grain twice or three times a day; infants tolerate mercury well, and rapid improvement usually follows. The signs of *fœtal* syphilis have been mentioned on page 120.

PART VII

OBSTETRIC OPERATIONS

Artificial Interruption of Pregnancy

It may be necessary or advisable to interrupt pregnancy either before the fœtus is viable (*induction of abortion*) or after it has become viable (*induction of premature labour*). We shall have to consider first the *indications* for interrupting pregnancy, and then the *methods* by which it may be accomplished.

A. Indications for inducing Abortion or Premature Labour

I. Induction of Abortion.—The indications may be divided into two groups—*general* and *local.*

(A) *General indications.*
  (1) Hyperemesis gravidarum.
  (2) Acute or chronic nephritis with a history of eclampsia in previous pregnancy; sometimes pyelitis.
  (3) Chronic valvular disease of the heart with failure of compensation.
  (4) Advanced pulmonary phthisis.
  (5) Insanity.
  (6) Chorea when not amenable to general treatment.

(B) *Local indications.*
  (1) Incarcerated retroversion, or irreducible prolapse, of the gravid uterus.
  (2) Extreme degrees of obstruction, when the alternative of Cæsarean section is refused by the patient—*e.g.*:

- (*a*) Pelvic contraction of extreme degree (see p. 302).
- (*b*) Atresia of the vagina or cervix.
- (*c*) Irremovable pelvic tumours, such as those of the pelvic bones, and carcinoma of the cervix.

(3) Severe uterine hæmorrhage—*e.g.*:
  - (*a*) Hydatidiform degeneration of the chorion.
  - (*b*) 'Threatened abortion' with dangerous hæmorrhage.

(4) Acute hydramnios.

(5) Retention of a dead ovum (occasionally).

Criminal Abortion.—It must be recollected that the induction of abortion, except for clear medical indications, is an offence against the law, and is punishable by imprisonment. It is therefore advisable, before inducing abortion, that a consultation should take place between two medical men, both of whom accept responsibility for what is to be done. Medical men are sometimes requested by married women to induce abortion because pregnancy is inconvenient or motherhood expensive; but for reasons so inadequate as this, the operation should not be performed.

II. **Induction of Premature Labour.**—Labour may be induced prematurely with two distinct objects: (1) to save the mother when urgent complications are present (*maternal indications*); (2) to enable the fœtus to pass without injury through a relatively or absolutely narrow pelvis (*fœtal indications*).

(A) *General indications.*—Those already mentioned as indications for inducing abortion will, when encountered later in pregnancy, indicate induction of premature labour. An important addition must be made—viz. *eclampsia*, and the toxæmic state which precedes it in cases where medical treatment has failed; this condition is very seldom met with before the child is viable.

(B) *Local indications.*

(1) Ante-partum hæmorrhage, when profuse or recurrent.

(2) Hydramnios, when attended with severe pressure-symptoms.

(3) Pelvic contraction of moderate degree.
(4) Abnormally large size of fœtus in previous pregnancies.
(5) Premature death of the fœtus *in utero* in previous pregnancies.

The greater number of the above indications have been already sufficiently discussed. One of these, however—viz. pelvic contraction—requires further consideration.

The object of inducing premature labour in *pelvic contraction* is to enable a viable fœtus to be delivered without injury. A child born as early as the twenty-fourth week will sometimes survive, but this is very exceptional. According to Bar, 80 per cent. of those born so late as the twenty-eighth week die; but the rate of mortality falls rapidly after this period to 50 per cent. at the thirtieth week, and 12 per cent. at the thirty-third week. It may therefore be said that unless the pelvis is large enough to allow pregnancy to continue till the thirty-second week induction involves risks to the child which are unnecessarily great, and some other method should be adopted. Experience of the operation has also shown that a viable fœtus has but a poor chance of ultimate survival in induced labour unless the conjugate of the brim measures at least 3½ inches in a generally contracted pelvis, and 3¼ inches in a flat pelvis. When the pelvis is smaller than this, two serious difficulties are necessarily encountered: (*a*) labour must be induced between the twenty-eighth and thirtieth weeks, when the fœtus, though viable, can seldom be reared; (*b*) the fœtal head may be injured in passing through the pelvic brim, and a fœtus of this period of development is unable to survive even slight injuries during labour. It will be remembered that the fœtal mortality of induction for greater degrees of pelvic contraction is very high (see p. 302). When the conjugate of the brim measures 3¾ inches there is a reasonable chance of delivering a full-time child; but in the case of a multipara with a degree of pelvic contraction between 3½ and 4 inches who has had previous difficult labour with loss of the child, induction would, of course, also be indicated. It will be noticed that a certain amount of restriction of the indications for inducing premature labour has been adopted in recent years. The mortality of Cæsarean section has been greatly diminished by aseptic methods and improvements in the technique of the operation, so that in the 'moderate' degrees of pelvic contraction (conjugate 2¾ to 3¼ inches) this operation is now preferred to induction.

The matter may accordingly be summed up by saying that induction for pelvic contraction is a suitable procedure only when the pelvis gives at least 3¼ to 3½ inches in the conjugate, and pregnancy can be allowed to continue at the least to the thirty-second week.

The approximate periods at which labour may be induced for different degrees of pelvic contraction are given in the following table: the calculation of the duration of pregnancy must be made mainly from the date of commencement of the last menstrual period, but this estimate can be roughly controlled by the height of the fundus above the symphysis pubis, as shown in the table.

True Conjugate				Period of Pregnancy	Height of Fundus
Flat Pelvis		Generally Contracted Pelvis			
[illegible] inches	[illegible] cm.	[illegible] inches	[illegible] cm.	[illegible] weeks	[illegible] inches
[illegible]	[illegible] cm.	[illegible]	[illegible] cm.	[illegible]	[illegible]
[illegible]	[illegible] cm.	[illegible]	[illegible] cm.	[illegible]	[illegible]
[illegible]	[illegible] cm.	[illegible]	[illegible] cm.	[illegible]	[illegible]

In the case of a flat pelvis the ample space in the transverse diameter allows the head to pass a somewhat narrower conjugate than is possible in the case of a generally contracted pelvis, where the transverse diameter is proportionately diminished.

In inducing premature labour it will clearly be of the greatest advantage to allow pregnancy to continue as long as possible, but success will depend largely upon a correct estimate being formed of the relation between the size of the [illegible] duce a fœtus of abnormally large size. An element of disturbance is thus introduced into the calculations.

Inasmuch as it is difficult to measure the pelvic diameters exactly by clinical methods, and inasmuch as the size of the fœtal head is subject to considerable variation, the date at which labour should be induced cannot be determined from the measurements alone. It is necessary to apply another test—viz. to determine from time to time that the fœtal head is not too large to pass into the brim of the pelvis. This may be done in two ways: (*a*) The patient lies upon her back, with the shoulders elevated on pillows. The head must be presenting, therefore external version must be first performed if any other part presents. Then the head in the lower uterine segment is grasped between the fingers of the two hands laid flat upon the sides of the uterus, as in the *first pelvic grip* (see p. 223), and pressed and pushed down into the brim. Pressure upon the fundus by an assistant is a great help in doing this. If there is plenty of pelvic space the head may thus be pressed down well into the brim, or sometimes it may be found already occupying that position.

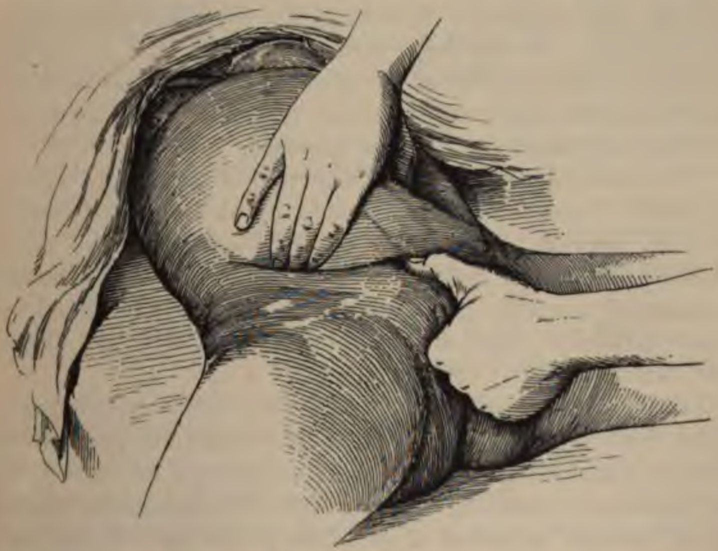

FIG. 238.—MUNRO KERR'S METHOD OF ESTIMATING THE RELATIVE SIZES OF THE HEAD AND THE BRIM IN PELVIC CONTRACTION.

(*b*) A bi-manual method may be employed; that here described and illustrated is the method of Müller as modified by Munro Kerr (fig. 238). The patient lies on her back; two fingers of the left hand are passed into the vagina and the thumb placed above the pubes in contact with the head; with the right hand the fœtal head is grasped and pushed downwards and backwards into the pelvic brim. The head can then be palpated by the thumb and fingers of the left hand, while it is pressed down into the brim with the right hand. The extent to which the head can enter the brim will then be recognised. As long as it is clear that the greatest circumference of the head can be pushed into the brim, pregnancy may be allowed to continue, but from the thirtieth week onwards weekly examinations should be made, so as not to allow the proper period to be exceeded.

The *maternal* mortality of induction of premature labour for *pelvic contraction* is so low as to be almost non-existent. In 1895 Tarnier reported 116 cases without a death; more recently, 391 cases collated by Whitridge Williams showed a maternal mortality of 1·03 per cent. When undertaken for grave *maternal complications* the true mortality of the operation cannot be fairly computed.

Local indications (4) and (5) are rarely encountered. Excessively large children are usually the result of protraction of the normal period of gestation (post-mature labour); such an occurrence resulting in the death of the fœtus in labour would indicate induction at or a little before term in the next pregnancy. Instances of death of the fœtus *in utero* after reaching the period of viability are often due to syphilis, but not all cases can be explained in this way; in some, the mother appears to be merely unable to provide in the later weeks for the proper nutrition of the fœtus. Induction of labour at a time earlier than the occurrence of fœtal death in previous pregnancies is the only possible treatment.

B. Methods of inducing Abortion or Premature Labour

The methods by which abortion or premature labour may be induced are various; they act either by directly exciting uterine contractions or by forcibly dilating the cervix. The selection of a method suited to the particular case sometimes calls for the exercise of care and judgment on the part of the operator. It may, however, be accepted as a general principle that the methods described as 'slow' should be preferred to the 'rapid' methods, except in cases where great urgency exists from the presence of serious maternal complications.

These methods may conveniently be divided into two groups, which exemplify somewhat different principles. In the first or *slow method* the object is merely to start the process of abortion or labour; in the second or *rapid method* the object is to dilate the cervix sufficiently to allow of the immediate natural expulsion or operative removal of the ovum or fœtus. Each of these objects may be attained in various ways, some of which are suitable to early, some to later pregnancy. The slow methods are less dangerous than the rapid methods, and should therefore generally be preferred. It will be understood that some of the rapid methods may also be employed to accelerate dilatation of the cervix when labour is already in progress.

Slow Methods.—(1) *Perforation of the Membranes and Vaginal Plugging.*—A sound is passed into the uterus with the object of rupturing the membranes, or detaching some part of the ovum from the uterine wall. An anæsthetic is not necessary, but the strictest antiseptic precautions are required for this simple procedure, and if the vulva, vagina, or cervix is the seat of purulent discharge the most serious risks of sepsis will be encountered. The maternal passages must be carefully douched and swabbed with a reliable antiseptic solution, the hands of the operator carefully disinfected, and the sound boiled or sterilised in the flame of a spirit lamp. With the aid of Sims's speculum the instrument is then passed into the cervix without touching any external part, and pushed through the membranes; in early pregnancy it may be carried up to the fundus and the point then rotated, and moved to and fro in contact with the uterine wall to detach or rupture the ovum; after the third month it is sufficient simply to perforate the lower pole of the membranes. The operation is completed by plugging the vaginal vault tightly, and the lower part of the vagina loosely, with iodoform gauze. This can be allowed to remain for twenty-four hours, and in the meantime ergot should be administered in full doses.

This method is successful for inducing *abortion*; at the second or third month painful contractions usually ensue in a few hours, and when the gauze packing is removed the ovum may be found lying in the vagina, complete abortion having taken place. A second packing is, however, not infrequently required.

When used to induce *premature labour*, rupture of the membranes is attended with the serious disadvantage that it prevents the formation of the bag of waters and so disturbs the normal mechanism of dilatation of the cervix; and further, its effect is uncertain, for unless a large quantity of liquor amnii is allowed to escape, labour pains will not be excited. It is now only used in cases of hydramnios, where it affords immediate relief to the pressure-symptoms. In such a case it is best to perforate the bag of waters with a sterilised bougie, passed first of all for a couple of inches between the membranes and the uterine wall. In this way a valvular opening is made through which liquor amnii will slowly escape, and the formation of a bag of waters will not be entirely prevented. Sudden escape of a very large quantity may induce serious syncope. It is unnecessary in these cases to plug the vagina.

(2) *Intra-uterine Bougie* (Krause's method).—This procedure consists in the introduction of one or more sterilised gum-elastic bougies into the uterus, between the membranes and the uterine wall; it is a very simple method, and requires only care and surgical cleanliness in its performance. The maternal passages must be healthy, and should be previously sterilised, as far as possible, by repeated douching. The bougies can be sterilised by boiling them for ten minutes; a convenient plan is to place three or four bougies in a glass catheter tube furnished with a rubber stopper and an outer metal case. The tube containing the bougies is placed unstoppered in a steriliser and boiled along with the rubber stopper. The tube can then be removed, and the rubber stopper inserted with the tube full of the boiled water, without exposing or touching the bougies. In this way bougies ready sterilised can be carried in the instrument bag with safety (fig. 289). The usual size employed is No. 10

or No. 12, but larger sizes up to 18 can be used with safety. After disinfection of the hands, the bougie is guided by the fingers into the cervix, and pushed up to the level of the internal os. The point is then directed towards the uterine wall and the bougie slowly pushed up into the uterus. The length of bougie which can thus be passed depends, of course, on the size of the uterus—*i.e.* the period of pregnancy; at or near term only about one inch will remain below the os externum. It is well to introduce a second bougie by the side of the first. The vagina should then be lightly plugged with iodoform gauze. Care must be taken not to push the bougie through the membranes, but if this accident happens and a little liquor amnii escapes, no great harm will follow. If any resistance to the advance of the bougie is met with, the placenta may be in the way; the bougie should then be withdrawn, and re-introduced in a different direction.

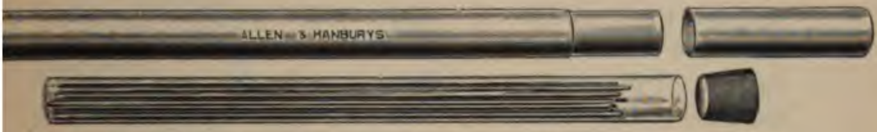

FIG. 239.—GLASS TUBE, RUBBER STOPPER, AND METAL CASE FOR CARRYING STERILISED BOUGIES.

This procedure invariably provokes labour, but the onset of labour pains is very variable. It is in common use at Queen Charlotte's Hospital, where it is found that the average interval between the introduction of the bougie and the delivery of the child is seventy-five hours; but cases have now and then occurred in which eight to ten days have elapsed. Even if labour pains do not come on, a little dilatation of the cervix sufficient to admit one or two fingers is usually produced in twenty-four to forty-eight hours. If there is no sign of the commencement of labour in twenty-four hours, another bougie should be introduced at the opposite side; a fourth may be put in after a further twenty-four hours if required. The bougies should not be removed when the pains begin, for this may cause them to cease.

Krause's method is simple and easy, and is accordingly well suited for general use. If due attention is paid to surgical cleanliness, bougies may remain for several days in the uterus and no harm will result. They usually become very soft after forty-eight hours' maceration in the uterus. If the membranes are accidentally ruptured during their introduction, it is little if any disadvantage if the opening so made is above the cervix; for the escape of fluid through this valvular opening is slow, and a small bag of waters is often formed notwithstanding. The disadvantage of the method is the uncertainty as to when labour will be terminated.

Rapid Methods.—(1) *Dilatation by Graduated Metallic Dilators.*—The patient is prepared as for the operation of curetting and an anæsthetic given. A duck-bill (Sims's) speculum is then passed, and the cervix seized with a strong pair of volsella forceps. The dilators (fig. 77), previously sterilised by boiling, are then introduced in series; after passing the largest size, the index finger can be easily passed through the internal os. This is the greatest extent of dilatation which can be produced by the dilators; towards the end of the process considerable laceration may occur at the level of the internal os, but if asepsis has been maintained no harm follows.

This method is consequently limited in its application. It will suffice for the evacuation of the uterus up to the end of the third month of pregnancy, the ovum being detached by the finger, and then expressed by compression or withdrawn by ovum forceps (see p. [illegible]). It is, however, often employed in combination with some other procedure. Thus after partial dilatation has been secured with vaginal plugging or by using a laminaria tent, the dilatation may be completed with metal dilators, and the uterus evacuated. Or again, it may be employed to secure sufficient dilatation to allow of the introduction of a hydrostatic or a branched dilator.

(2) *Hydrostatic Dilators.*—Dilatation of the cervix by the introduction into the uterus of rubber or silk bags and their forcible distension with water is a method which has been in vogue for many years. Only one form of hydrostatic dilator need be described—viz. that of Champetier de Ribes, for it has superseded all others. The principle upon which its action is based will become clear when the construction and the method of using it have been described.

Champetier's dilator is a curved [illegible] bag, cylindrical [illegible] cross section, and made of strong silk covered with indiarubber or gutta-percha (fig. 240); it is therefore impervious and inelastic, it preserves its shape when distended, and can be sterilised by boiling. The broad upper end measures, when fully distended in the two sizes usually supplied commercially, $4\frac{1}{2}$ inches and $3\frac{1}{2}$ inches in diameter; the curve enables it to lie accurately in the axis of the pelvic canal. When in position the broad end lies in the lower uterine segment, above the level of the pelvic brim, the lower end protrudes from the vulva (fig. 241). To this end is attached a rubber tube, through which fluid can be pumped into the bag, and a tap to retain it there. It is not advisable to distend the bag to its utmost capacity with

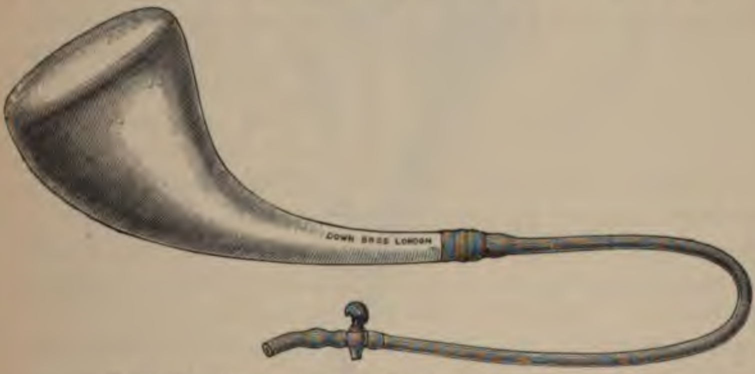

Fig. 240.—Champetier de Ribes's Hydrostatic Bag.

water, as it then becomes very rigid; it is sufficient to introduce into the larger size about fourteen ounces, into the smaller about eleven ounces. It cannot be passed through the undilated cervix: if the cervix admits one finger, the bag can be introduced under an anæsthetic; if it admits two fingers, an anæsthetic is often not required. Therefore, when used to induce labour, it may be necessary to partially dilate the cervix by some other method, such as the use of graduated metal dilators, or plugging the vagina and cervix with iodoform gauze.

The bag must first be sterilised by boiling for ten minutes, it should be filled with water and the tap left open before being placed in the steriliser, so that the boiling water can circulate through it and sterilise it both inside and out. Then it is immersed in a solution of 1-4,000 biniodide of mercury if not used immediately. The genital passages must be douched and swabbed, and the operator's hands carefully sterilised.

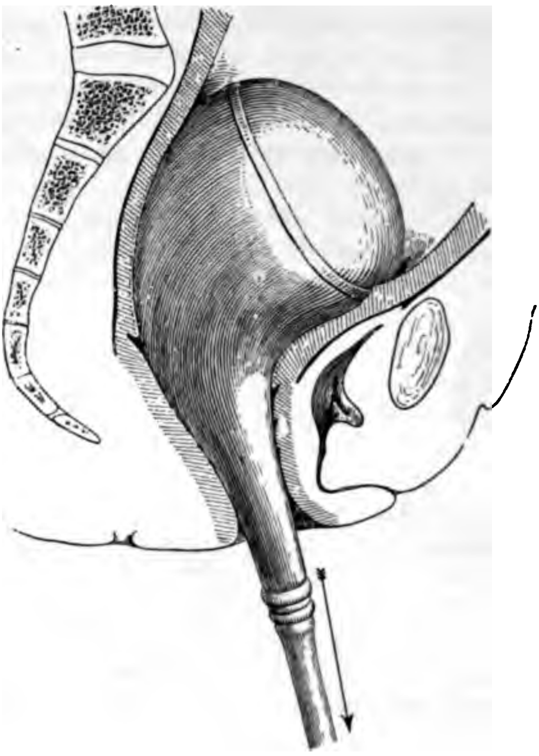

FIG. 241.—CHAMPETIER'S DILATOR INTRODUCED INTO THE UTERUS. (EDGAR.)

The bag is then rolled up into the smallest possible bulk and held in a pair of sterilised forceps; special forceps may

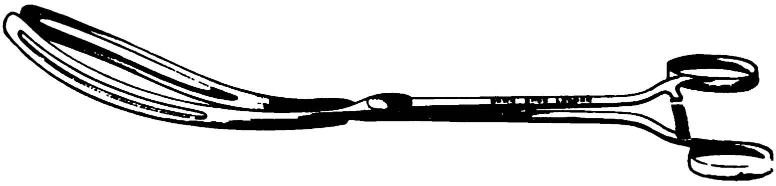

FIG. 242.—CHAMPETIER'S FORCEPS.

be obtained with curved blades (fig. 242), but an ordinary pair of ovum forceps will serve the purpose equally well.

Two fingers of the left hand are used to guide the forceps into the cervical canal, and the *broad base* of the bag is then pushed up well above the level of the internal os. The forceps is then withdrawn, and boracic lotion (1-40), or boiled water, pumped into the bag with a syringe; the capacity of the bag should have been previously measured, and only the quantity of fluid required sufficiently to fill it should be injected, or it may burst. If the bag has not been pushed far enough into the cervix, it will escape into the vagina as it becomes distended; if the broad end lies above the internal os, its shape will prevent its escape in this manner.

Champetier's bag, as a rule, is introduced between the membranes and the uterine wall; when distended it therefore causes extensive separation of the membranes from the wall of the lower uterine segment. If, however, while introducing it the membranes should be accidentally ruptured, no harm will follow, for the distended bag prevents escape of the liquor amnii. An important exception to this rule is the case of placenta prævia; here the membranes should first be ruptured and the bag then introduced into the amniotic sac, so that when distended it may compress the placenta against the uterine wall and so tend to check hæmorrhage.

The normal mechanism of labour is closely imitated by the action of Champetier's bag. Its curved conical shape corresponds to the shape of the dilating cervix and lower uterine segment, while its fluid consistence resembles that of the normal dilator—the bag of waters. When the membranes have ruptured, escape of liquor amnii is prevented by it. Its action depends upon its exciting uterine contractions by which it is driven gradually down through the cervix, distending it as it passes. When the pains excited by it are feeble, dilatation can be assisted by traction on the lower end of the bag. Traction may be applied intermittently by pulling during the pains, or continuously by attaching a weight of four to six pounds to the end of the tube and carrying it over the foot of the bed. Ultimately the whole cervical canal is stretched to the diameter of the broad end, and any intra-uterine manipulation required to deliver the child can therefore be immediately undertaken. When the broad end has been driven out of the cervix the contents may be allowed to escape and the bag then withdrawn. As a rule, the uterine pains

than any other method hitherto considered. Bossi's cervical dilator is shown in fig. 243. It consists of four blades, controlled by a screw which is worked from the handle of the instrument; by an ingenious device in the arrangement of the blades, the points can be widely opened without causing much separation of the blades, so that the vaginal canal is not dilated. The points are conical in shape and corrugated on their outer surface; when in apposition the closed end of the instrument has approximately the same bulk as the index finger; when the points are separated to their fullest extent the diameter of the open end is about 3½ inches. The handle is furnished with a scale upon which is indicated the amount of separation of the points in all positions. Caps of different sizes with a wide shoulder at the free end are provided which can be fitted on to the points so as to afford broader surfaces of contact in the later stages of the process (see fig. 243). The instrument is difficult to sterilise, as it is bulky and cannot be readily taken to pieces.

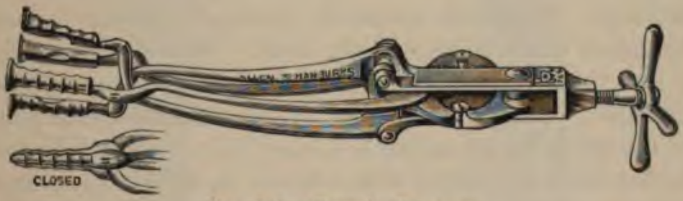

FIG. 243.—BOSSI'S DILATOR.

The open blades are fitted with broadening caps; the closed blades are not.

In using this dilator an anæsthetic is necessary, and the dorsal posture is the most convenient. Under strict antiseptic precautions with regard to the operator, the instrument, and the genital canal, the dilator is introduced with the right hand and the closed points guided with two fingers of the left into the cervix, which must be dilated, either naturally or artificially, sufficiently to receive it. The handle is then depressed towards the perineum so as to allow the points to come forward into the axis of the brim, for the instrument is nearly straight. It must be cautiously introduced during the intervals if labour is in progress. If the presenting part is in the way, this must be carefully pushed up into the uterus. It is immaterial whether or not the membranes have ruptured. As soon as the points are in the cervix the screw is turned and sufficient separation secured to cause distinct tension on the cervix. Dilatation is now carried out by turning the screw from one-fourth to one-half of a revolution during an interval, and then allowing two or three pains to recur before dilating further. The finger of the left hand must be kept in the cervical canal, so that any tendency of the points to slip may at once be recognised. When fully dilated the instrument is first closed and then withdrawn, and labour allowed to terminate naturally unless indications for immediate delivery are present: forceps is preferred to version as the method of delivery after the use of this instrument.

Severe lacerations of the cervix and lower uterine segment have been frequently reported in the use of this dilator; they appear to result either from the points slipping, or from hurried dilatation. A greatly improved pattern has been recently introduced by de Seigneux (fig. 244). This observer points out that there is a radical fault in the construction of Bossi's instrument—viz. that the blades separate in a horizontal plane, and the cervix is consequently dilated in a horizontal plane, whereas dilatation ought to be effected in an oblique plane—the plane of the pelvic brim. When the anterior blade of Bossi's instrument is at the level of the internal os, the posterior blade will impinge upon the posterior cervical wall considerably below this level. Dilatation must therefore be irregular, and laceration of the posterior cervical wall will be favoured. In de Seigneux's instrument the blades separate in an oblique plane corresponding to that of the pelvic brim, the result being that the internal os can be evenly dilated. A series of blades having points of different sizes is employed by de Seigneux during the process of dilatation. He claims that there is less danger of laceration with his instrument than with Bossi's, and it seems reasonable to expect that this will prove to be the case when it has been extensively tried.

At the present time great divergence of opinion exists as to the value of this method of dilatation; its efficiency cannot be denied, but the force exerted by it is very difficult to regulate, and serious lacerations of uterus and vagina have undoubtedly been caused by it even when used by skilled operators. As a method of inducing labour its use is practically restricted to the most urgent instances of maternal complications; but it has also been frequently employed to complete dilatation of the cervix rapidly after labour has begun.

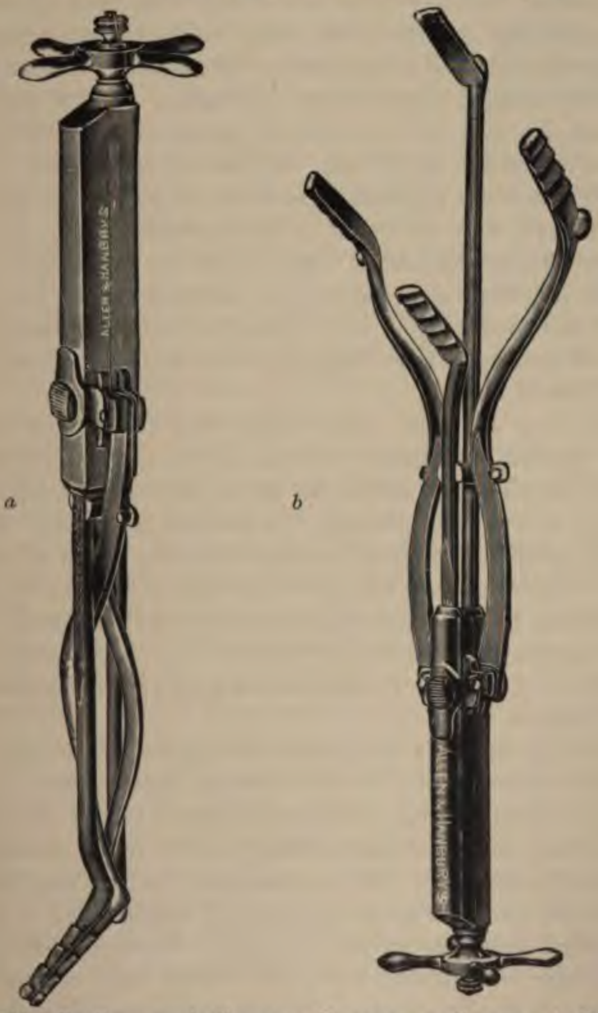

FIG. 244.—DE SEIGNEUX'S CERVICAL DILATOR. *a*, CLOSED. *b*, OPEN.

(4) *Digital Dilatation of the Cervix.*—When the cervix is sufficiently dilated to admit one or two fingers, full dilatation may be produced by digital stretching. The thumb and index finger of one hand are first inserted, and the cervix stretched as far as possible by separating them. Then the

remaining fingers are successively introduced, until all the fingers of the hand can be passed through the internal os. Another method in which both hands are employed is also used; after two fingers of one hand have been passed, the corresponding fingers of the other hand are introduced, and the cervix stretched by separating the fingers of the two hands.

This method requires an anæsthetic, careful antiseptic precautions, and the exercise of gentleness and patience in its performance; even then very serious lacerations running up into the lower segment, and even complete rupture of the uterine wall, may occur, for it is impossible to graduate the amount of force applied in this manner. It is consequently seldom practised as a method of inducing labour, but it may safely and conveniently be employed to complete dilatation in cases of prolonged first stage when the cervix is already one-half dilated.

(5) *Deep Incision of the Cervix and Lower Uterine Segment* (Vaginal Cæsarean section).—This method consists in deeply incising the cervix so as to allow of the immediate delivery of the child through the natural passages. It must not be confounded with the time-honoured plan of making shallow incisions into the lips of the cervix to promote dilatation, which has been described on page 318 in connection with the treatment of rigidity of the cervix. The method here referred to is of quite recent date, and was introduced in 1896 by Dührssen.

The operation is performed as follows by Bumm. The cervix is first exposed by two specula, then seized with two pairs of volsella forceps, and pulled down to the level of the ostium vaginæ. A median incision is then made, commencing on the anterior lip of the os externum, and passing over the cervix and forwards on to the anterior vaginal wall to a point two inches above the urinary meatus. Through this incision the bladder is separated from the uterine wall by blunt dissection. A median incision is then begun in the cervix and carried upwards to the level of the internal os; the cervix can be pulled down lower and lower during the process so as to keep the whole incision well within view. When the internal os has been incised the bag of membranes will present. The peritoneum of the utero-vesical pouch is pushed up out of the way, but is not incised. The uterine incision is carried a little higher, and then the membranes are ruptured, and delivery effected by podalic version. The uterine incision measures about four inches, so that it involves both cervix and lower uterine segment. After delivery of the placenta, the cervix is again pulled down to the vulva and the deep incision closed with interrupted catgut sutures from above downwards. Finally the incision in the vaginal wall is similarly closed.

This operation is difficult in a primipara on account of the small size of the vagina and the rigidity of the perineum. It cannot be performed unless the maternal pelvis is of normal size, and up to the present time it has been applied almost solely to cases of eclampsia in which it was desired to deliver rapidly. The mortality is high, and fifty-five cases recently reported showed a maternal mortality of 20 per cent., but it must be recollected that the maternal conditions for which it was undertaken were very grave.

Accouchement forcé.—This name is sometimes used to include delivery by certain rapid methods of dilatation – *i.e.* by Bossi's dilator, and by vaginal Cæsarean section.

Selection of Methods for Particular Cases.—In inducing *abortion* the method to be employed varies with the period of pregnancy. Up to the end of the third month the uterus can safely and conveniently be emptied at a single sitting, by dilating the cervix with metal dilators and clearing out the contents of the uterus with the finger or ovum forceps. The same may be done in the fourth and fifth months, if the maternal indications are urgent; dilatation must then be carried further by the digital method. If a slower method is desired, the sound should be used so as to rupture or detach the ovum, and the vagina then plugged with iodoform gauze, and full doses of ergot administered; or a laminaria tent may be introduced into the cervix. As soon as the cervix is sufficiently dilated the contents of the uterus should be evacuated. The instruments of Bossi and de Seigneux are unsuitable for inducing abortion. In inducing *premature labour* for pelvic contraction the simplest method is that of Krause. A much quicker result can be obtained by introducing Champetier's bag as soon as sufficient dilatation for this purpose has been obtained by bougies. For urgent maternal complications Champetier's bag will usually suffice, the necessary preliminary dilatation being in this case rapidly secured by graduated dilators; in this way labour may often be set going and terminated under twelve hours. Only in extremely urgent cases can it be justifiable to use branched dilators or deep vaginal incisions. These procedures have been chiefly employed in urgent cases of eclampsia and ante-partum hæmorrhage, and the doubtful propriety of rapidly evacuating the uterus in these conditions has been already discussed.

Version: Turning

This operation consists in altering the lie of the fœtus *in utero*, so as to substitute one presentation for another; either the head or the breech may be brought down into the pelvic brim, version being termed *cephalic* in the former and *podalic* in the latter case. The conditions in which it may be necessary to perform version are as follows:

(1) Transverse presentation.

(2) Face or brow presentation.

(3) Flat pelvis, if the true conjugate measures at least three inches, and the transverse is not diminished.

(4) Placenta prævia.

(5) Prolapse of the umbilical cord.

(6) Breech presentation in a primipara.

(7) Whenever immediate delivery is indicated and the use of forceps is undesirable.

The advantages of turning in these conditions has been discussed already in connection with each individually, and therefore they need not be reconsidered here.

Version may be performed by external (abdominal) manipulations alone, by internal manipulations alone, or by combined internal and external manipulations; these methods are respectively termed *external*, *internal*, and *combined* or *bi-polar*.

External Version.—The fœtus *in utero* can be turned by abdominal manipulation if there is a sufficiency of liquor amnii, if the uterus is not contracting frequently and powerfully, and if the abdominal walls are lax. The time for its performance is therefore before labour sets in, or very early [illegible]; it is much easier in a multipara than in a primigravida. The commonest indications for its employment are transverse and breech presentations.

Transverse Presentation.—When a tranverse presentation is associated with a flat pelvis it is best to convert it into a pelvic presentation ; under other circumstances a head presentation should be produced. In performing external version the patient should lie on her back with the shoulders slightly raised and the legs flexed. The fœtal head usually lies in one or other iliac fossa. The two hands of the operator are first used to gently raise the trunk of the fœtus out of the pelvic brim ; then the hands are placed upon opposite fœtal poles, and the two poles are pushed by gentle and sustained pressure in opposite directions (right and left) towards the middle line, so as to bring the head into the brim, the breech up to the fundus. When this has been done, firm downward pressure is made upon the breech so as to cause the head to descend well into the brim and flex the trunk of the fœtus ;

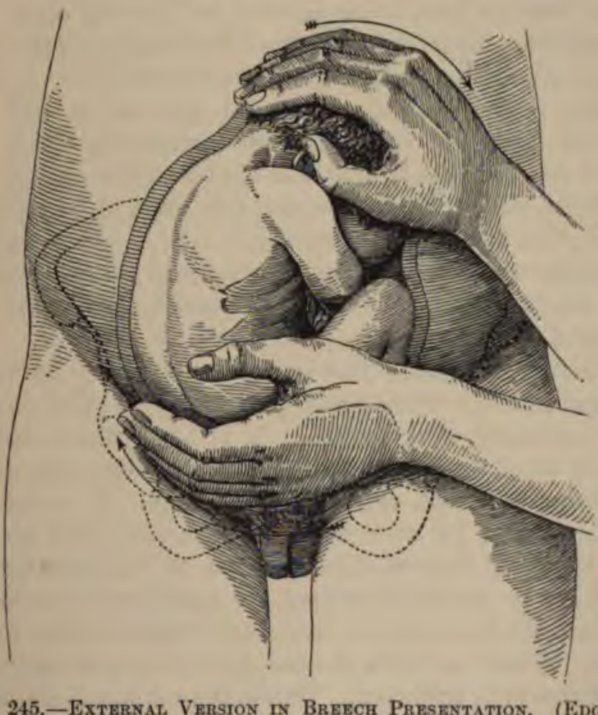

FIG. 245.—EXTERNAL VERSION IN BREECH PRESENTATION. (EDGAR.)

a tight abdominal binder is then applied. Unless labour is sufficiently advanced to make rupture of the membranes justifiable at the end of the operation, the mal-presentation is likely to recur.

Breech Presentation.—The method employed is very similar. The breech is first raised out of the brim, and then pushed to one side until it lies in the iliac fossa (fig. 245). Gentle and continuous pressure is then made upon the fœtal poles in opposite directions (right and left), away from the middle line, the head being directed to the side upon which the limbs lie. By pushing the head downwards and the breech towards the fundus, the presentation becomes first transverse and then cephalic. Firm downward pressure is then made upon the fundus to cause the head to enter the brim. It is difficult to carry the long axis of the fœtus through the short transverse axis of the uterus, and this stage of the operation is therefore the most difficult. If labour has begun, the manipulations should be made chiefly in the intervals between the pains when the uterus is relaxed, and the operation completed by rupturing the membranes.

Internal Version.—This operation consists in introducing the hand into the uterine cavity in order to bring down the pelvic extremity of the fœtus. It is by no means devoid of risk, and should not be performed except under perfectly clear indications and with requisite precautions. It is absolutely contra-indicated by tonic uterine contraction: and whenever some time has elapsed since rupture of the membranes it should not be attempted unless the mobility of the fœtus is good, and the hand can be introduced without force into the uterus. When the fœtus is dead, embryotomy or craniotomy should always be preferred. Unless the conjugate diameter of the pelvic brim measures at least three inches, version is an unsuitable method of delivery in a flat pelvis, and in all degrees of generally contracted pelvis it should be avoided. The strictest antiseptic precautions are called for, and the manipulations must be carried out with gentleness and deliberation: only in this way can the risks of sepsis and rupture of the uterus be reduced to a minimum. An anæsthetic should always be administered. The most favourable moment for performance of the operation is when the cervix is about three-fourths dilated and the membranes are unruptured:

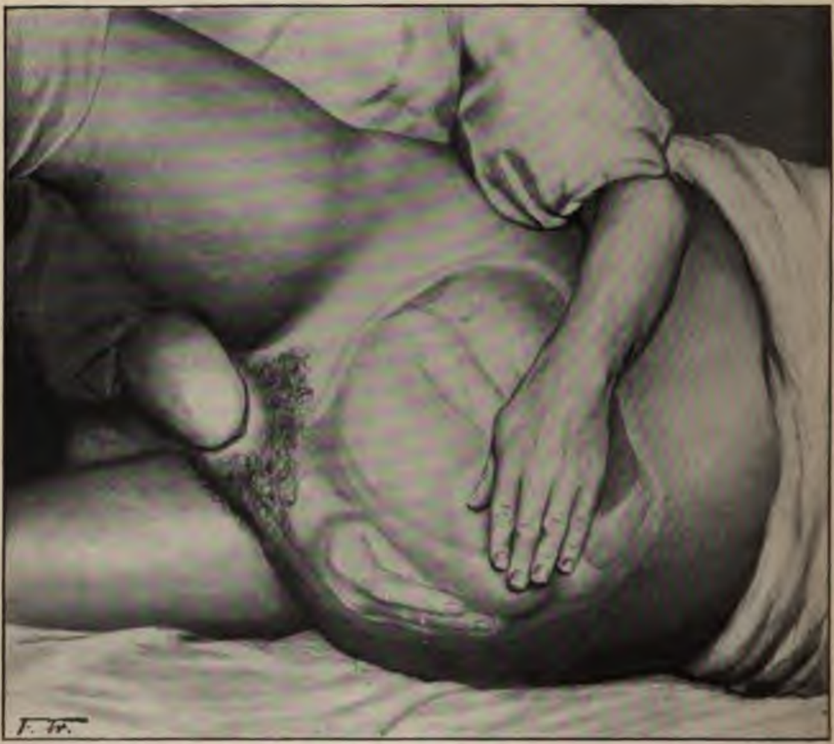

FIG. 246.—INTERNAL VERSION IN TRANSVERSE PRESENTATION: DORSO-ANTERIOR POSITION. INTRODUCTION OF HAND INTO UTERUS. (NAGEL.)

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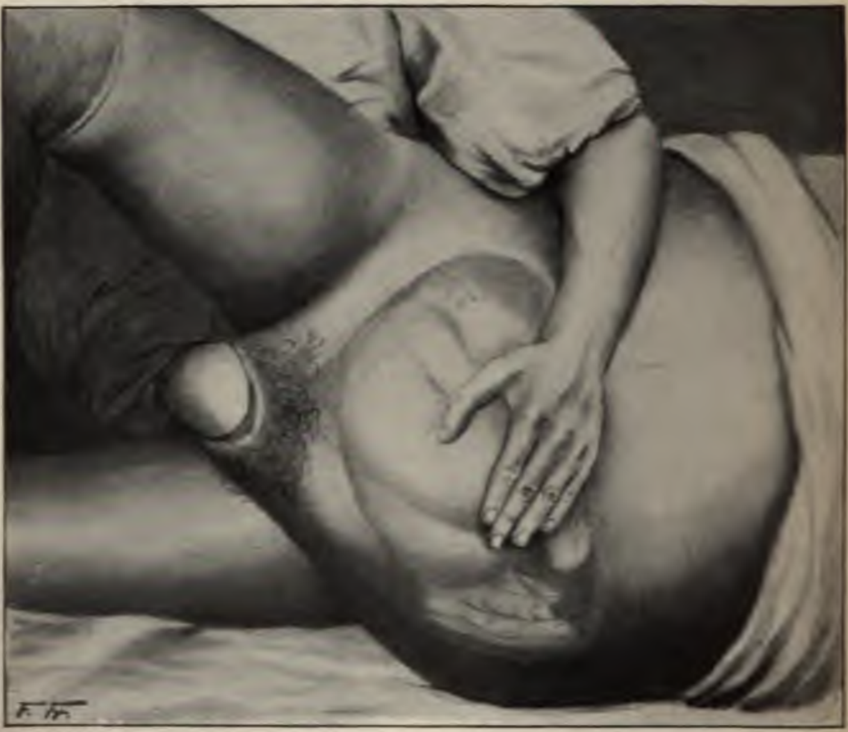

Fig. 247.—Internal Version in Transverse Presentation:
Seizing the Lower Foot. (Nagel.)

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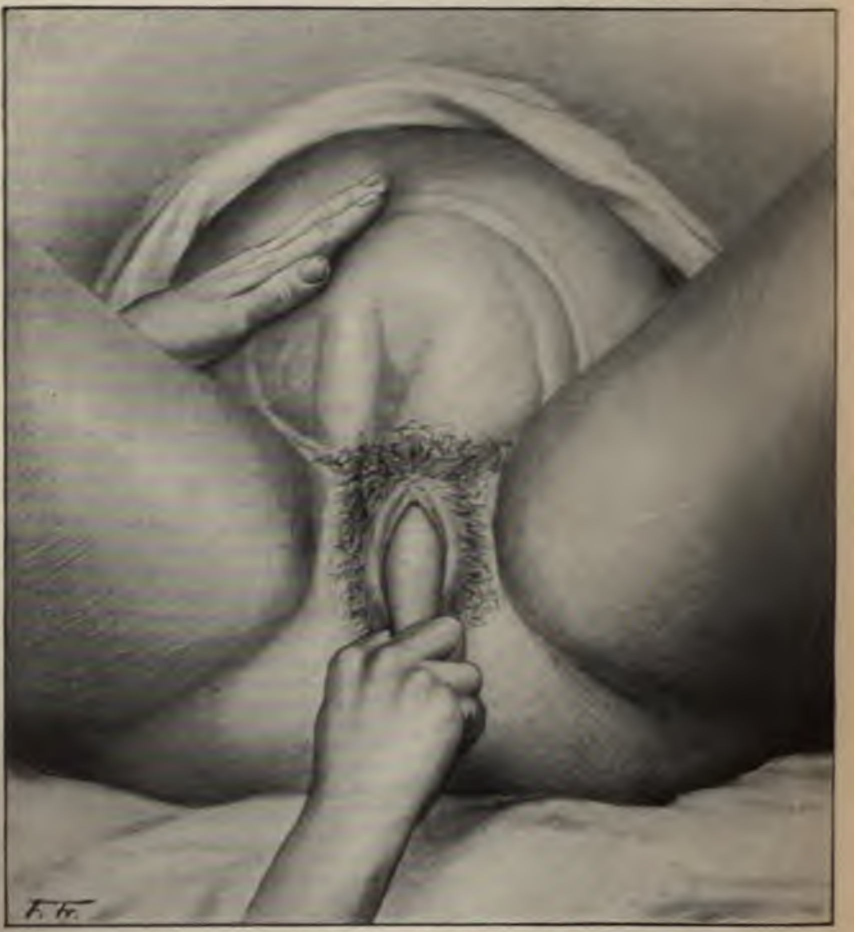

FIG. 248.—INTERNAL VERSION: LEG DRAWN DOWN INTO THE VAGINA, HEAD PUSHED UP TO THE FUNDUS. (NAGEL.)

[*To face p.* 497.

but, when required, the cervix can be stretched to this extent by the digital method, under anæsthesia, during the operation.

Preliminaries. — The bladder should be emptied by catheter. The position of the back and head of the child should be carefully localised by abdominal and vaginal examination, and the fœtal heart auscultated. The approximate size of the pelvis and of the fœtus must also be estimated. The patient may be placed in either the 'lithotomy position' or the ordinary lateral posture; in the latter less assistance is required by the operator. The operator, after carefully disinfecting his hands and forearms, should put on a pair of previously boiled rubber gloves, and the vulva and vagina of the patient should be swabbed with an antiseptic solution (biniodide of mercury 1-2,000, or lysol ʒj. to Oj.).

Steps of the Operation.—(*a*) *When the presentation is transverse.*—When the head lies to the right the patient should be placed on her left side, with the buttocks over the edge of the bed, the operator using his right hand for the internal manipulations (fig. 246). When the head lies to the left side, the patient should be placed on her right, the operator using his left hand.

(1) The hand should be passed into the vulva with the fingers and thumb bent into the shape of a cone; the direction to be taken is at first upwards and backwards (axis of outlet), gradually changing to upwards and forwards (axis of brim).

(2) The hand should not enter the uterus until the strong contractions and expulsive efforts excited by its introduction into the vagina have passed away.

(3) In dorso-anterior positions the hand should follow the curve of the lower buttock until the *lower* foot can be reached, the external hand raising the pelvic pole of the fœtus so as to render it more accessible (figs. 246 and 247).

(4) In dorso-posterior positions the hand should be passed over the ventral aspect of the fœtus, so as to reach the *upper* foot, aided by the external hand.

(5) When the foot has been seized, it should be drawn gently down into the vagina, the head being at the same time pushed up towards the fundus by the external hand (fig. 248). The patient may now be placed in the dorsal position (as in

the figure), or delivery may be completed without change of position.

(6) These manipulations should as far as possible be made during the intervals of the contractions, the internal hand making no advance during the pains.

(7) The fœtus may now be extracted; this should be carried out *with the aid* of the uterine contractions, firm and continuous pressure being at the same time made upon the fundus. In some cases—*e.g.* placenta prævia—it is best to allow the child to be expelled by the natural efforts, and not to practise extraction.

(8) After the delivery of the after-birth an antiseptic intra-uterine douche should always be given.

(9) Owing to the risks of fœtal asphyxia, preparations for the resuscitation of the infant should be made. When an arm has prolapsed, a piece of tape should be placed round the wrist before turning, so that during delivery upward displacement of the arm may be prevented by traction on the tape.

(*b*) *When the head presents.*—The position of the back of the fœtus must first be located. When the back lies to the right of the mother, the patient should be placed upon her left side, the operator using his right hand for turning; when the back lies to the left of the mother, she should be placed upon her right side, the operator using his left hand (fig. 249). The steps of the operation are the same as in a transverse presentation, the hand being always passed along the ventral aspect of the fœtus; one or both feet may be seized in turning. When the hand enters the uterus, the head is necessarily pushed to one side, thus facilitating its displacement upwards by the external hand. It is more difficult to turn a head than a transverse presentation, as the long axis of the fœtus is made to cross the transverse axis of the uterus.

Combined or Bi-polar Version. (Method of Braxton Hicks.)—During the first stage of labour, when the cervix sufficiently dilated to admit one or two fingers, and the branes are unruptured, or, if ruptured, a large amount of r amnii remains, it is possible to turn without introducing hand into the uterus. It is evident that in internal version h external and internal manipulations are employed, and poles of the fœtus are displaced; it might therefore also

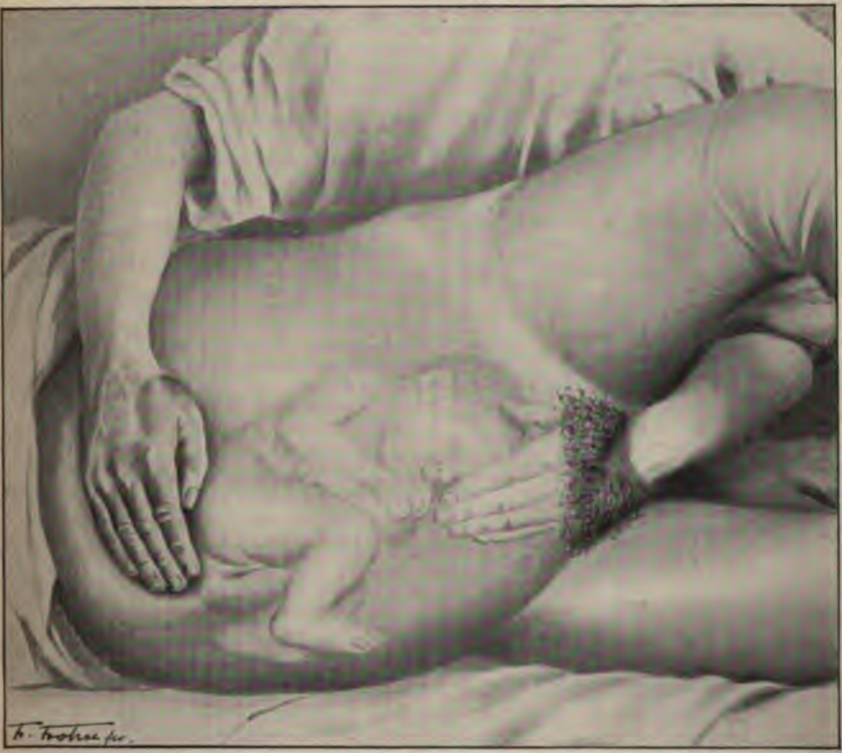

FIG. 249.—INTERNAL VERSION: HEAD PRESENTATION. INTRODUCTION OF THE HAND INTO THE UTERUS. (NAGEL.)

[*To face p.* 498.

be accurately called combined or bi-polar version. The essential difference between internal version and the method now to be described is that, as in the latter the whole hand is not introduced into the uterus, it can be performed at an earlier stage of labour. It is not frequently performed, for it is more difficult than either of the other methods, the chief difficulty being met with in carrying the long axis of the fœtus through the transverse axis of the uterus. In transverse it is easier than in vertex presentations. Bi-polar version is usually *podalic—i.e.* it is used to produce a breech presentation.

Preliminaries. — These are the same as for internal version; an anæsthetic, though not essential, is of great assistance.

Steps. (*a*) *When the presentation is transverse.*—The right hand is always employed for the internal manipulations, the patient being in the dorsal or left lateral position.

(1) The position of the head having been located, the presenting shoulder is pushed upwards out of the brim, and *towards the side where the head lies*; the external hand assists by pushing the head upwards towards the hypochondrium.

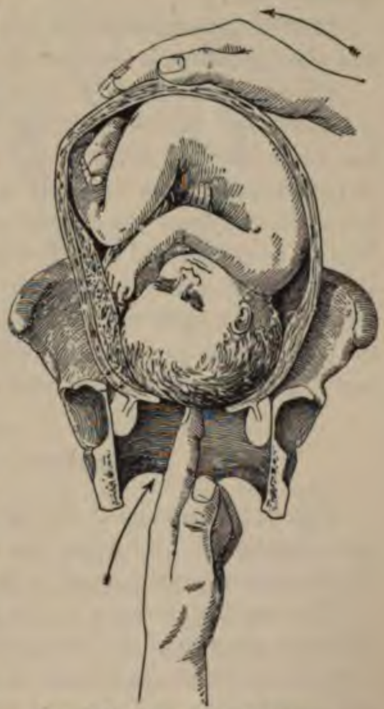

FIG. 250.—BI-POLAR VERSION: FIRST STEP IN HEAD PRESENTATION. PLACENTA PRÆVIA. (BRAXTON HICKS.)

(2) The arm or some part of the trunk now lies over the internal os, and is pushed into the iliac fossa on the same side, the head being simultaneously displaced upwards and towards the middle line into the epigastric region.

(3) The breech or lower limbs now come within reach of the internal fingers; the membranes are then ruptured, and one foot pulled down into the vagina, while the head is pushed

up to the fundus. The case is then managed as a breech labour, delivery being left to nature.

(*b*) *When the head presents.*—(1) The head is pushed upwards out of the brim, and then into the iliac fossa *on the side to which the back of the fœtus lies* (fig. 250); at the same time the breech is displaced downwards and to the opposite side.

(2) The presentation has now become transverse, or oblique, and the operation is completed in the manner just described.

Choice of Method of Version.—This is very simple, and is determined almost entirely by the stage of labour which has been reached when the necessity for version arises or is recognised. The external method should always be preferred if the local conditions admit of its being performed. It must be recollected that the external and combined methods are practised solely to correct an unfavourable presentation, delivery being afterwards left to nature; internal version, on the other hand, is usually completed by extracting the fœtus, and it accordingly may be used as a method of rapid delivery.

Obstetric Forceps

The construction of the modern obstetric forceps will be best understood by tracing the various phases through which the instrument has passed in its evolution.

The earliest forceps to be publicly described was that of Palfyn, a surgeon of the city of Ghent, in 1720. It consisted of a pair of spoon-shaped blades with wooden handles; the blades were applied to the sides of the head, and the handles tied firmly together so that the instrument could be used for traction. Before this period (seventeenth century), an instrument had been used in London by a family of doctors, including at least three generations, named Chamberlen; the construction of their forceps was, however, maintained as a strict family secret, and not until long after the death of the last of their line did the secret leak out. In 1813 the three forceps represented in fig. 251 were found by accident in an old chest in a house which one hundred years previously had belonged to the Chamberlens, and are believed to be the instruments with which they worked. These three forceps were distinctly [illegible]ter than Palfyn's; they consisted of a pair of metal, spoon-shaped, fenestrated blades, united like a pair of scissors with a pin-joint, and having curved scissors handles; slight modifications in shape appear in the three forms, and in one

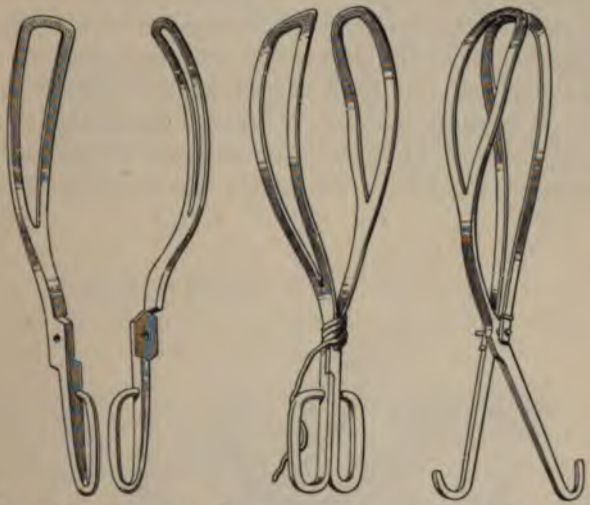

FIG. 251.—DIFFERENT PATTERNS OF CHAMBERLEN'S FORCEPS.

a tape threaded through and around the blades replaces the pin-joint. They are composed of three parts: (1) the curved blade, (2) the lock or joint, and (3) the handle; the curve, being designed to adapt the blades to the fœtal head, is known as the *fœtal* or *cephalic curve*. This is the only curve upon these early instruments; viewed in profile, they are straight from end to end.

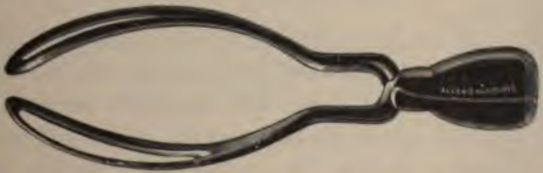

FIG. 252.—SHORT OR STRAIGHT FORCEPS.

A forceps constructed upon this principle, and called the *short* or *straight forceps*, was used for some purposes until comparatively recent years, but has now been generally abandoned (fig. 252).

The faults of this forceps are easily demonstrated. The instrument is straight, but the pelvic canal, in which it has to lie, is curved; therefore, in grasping the fœtal head *at the brim*, a central grip cannot be obtained, for the instrument will seize the part of the head which lies behind the centre (fig. 253). In occipito-anterior positions, traction thus applied to the sincipital end of the head would induce extension. And further, in making traction, a great deal of the force will be misapplied; for, while the head must travel downwards and backwards in the line of the axis of the brim (fig. 253, *a*, *b*), the direction of traction exerted by the forceps is in a line (*e*, *x*, *f*) intermediate between this and the axis of the outlet (*c*, *d*). A great deal of force will therefore be lost, and the soft parts crushed which lie between the head and the pubes. The misdirection of force is represented by the 'angle of error,' *b*, *x*, *f*. The application of this instrument to the head *in the pelvic cavity* is also open to objection, for it cannot be made to travel in any part of the pelvic axis without loss of much of the force applied.

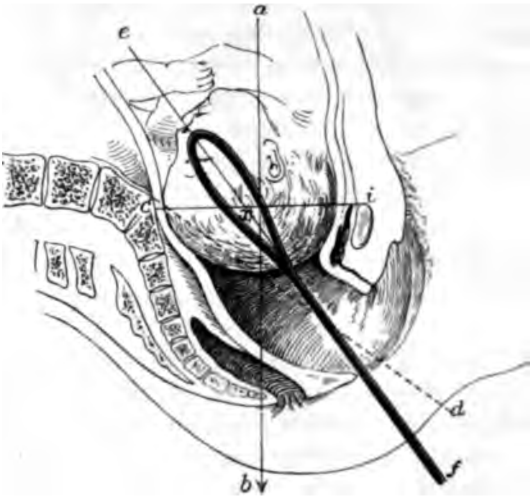

FIG. 253.—STRAIGHT FORCEPS APPLIED TO THE HEAD AT THE BRIM (SCHEMATIC). (MILNE MURRAY.)

a, *b*. Axis of pelvic brim. *c*, *i*. Plane of pelvic brim. *c*, *d*. Axis of pelvic outlet. *e*, *x*, *f*. Direction of traction made by forceps.

The first observer who attempted to remedy the faults of the straight forceps was Levret, of Paris (1751), who curved the blades forwards, so that they would lie accurately in the curve of the pelvic canal (fig. 254): this second curve has become known as the *maternal* or *pelvic curve*. Minor modifications were made by a Scotchman named Smellie, who invented the double-slot lock, now used in all British forceps, and introduced between the blade and the lock a straight portion, 2½ inches long, named the *shank*, which increased the length of the instrument so that the operator could lock it outside the vulva when applied to the head at the brim (fig. 255). The result of these alterations was thus to lengthen the forceps and add the pelvic curve. This instrument is now known as the *long* or *curved forceps*. As constructed at the present day, it is made entirely of metal, so that it can be boiled. The total length of the instrument is 15 inches; the cephalic curve of the blade has a radius of 4½ inches, and allows a maximum separation in the centre of 3⅜ inches, with a minimum separation at the points of 1 inch; the pelvic curve has a radius of 7 inches.

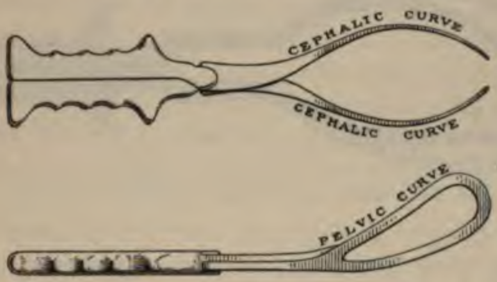

FIG. 254.—OBSTETRIC FORCEPS, SHOWING THE CEPHALIC AND PELVIC CURVES. (EDGAR.)

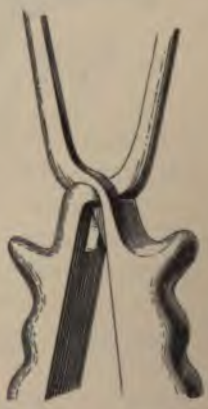

FIG. 255.—THE DOUBLE SLOT (ENGLISH) LOCK, AND SHANKS.

The great advantage of the pelvic curve is that it enables the forceps to obtain a central grip of the head, which does not disturb its attitude; but as in the case of the straight forceps there is great misdirection of the line of traction (compare figs. 253 and 257). The direction of traction exerted by the instrument is represented by a line joining the handles with the centre of the fenestrum (fig. 257, *e*, *x*, *f*). This line does not pass through the centre of the pelvis at all, but lies entirely in front of it when the instrument is applied to the head at the brim; its direction also diverges widely from the axis of the brim. The misdirection of force is represented by the angle *b*, *x*, *f*.

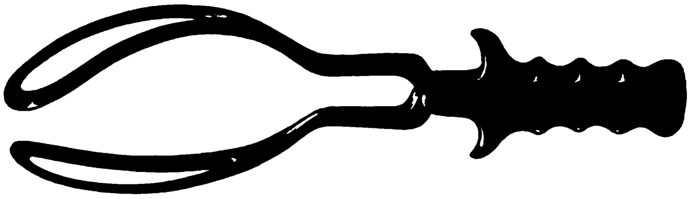

FIG. 256.—LONG OR CURVED OBSTETRIC FORCEPS.

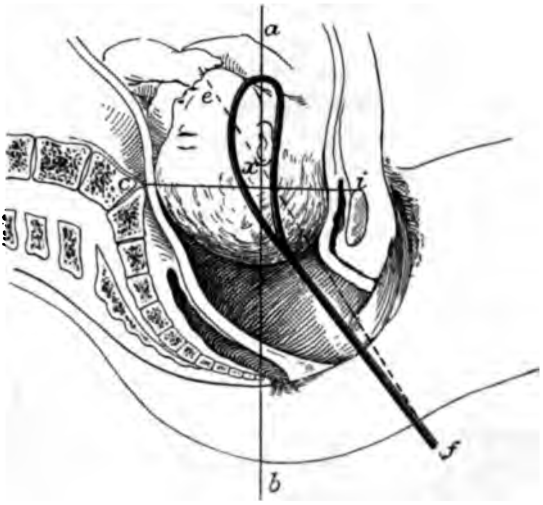

FIG. 257.—LONG FORCEPS APPLIED TO THE HEAD AT THE BRIM. (MILNE MURRAY.)

a, *b*. Axis of pelvic brim. *c*, *i*. Plane of pelvic brim.
e, *x*, *f*. Direction of traction made by forceps.

The long forceps received a further important modification at the hands of Tarnier, of Paris, in 1877. This observer first introduced the principle of *axis traction*—*i.e.* he modified the instrument so that wherever the head may lie traction may be accurately applied to it in the *axis* of the pelvis, thus enabling all the force exerted to be employed in the most advantageous manner. This he did by adapting to the ordinary long forceps used in France a pair of curved metal rods by which traction could be made, known as the *axis-traction rods.* There are a number of points of difference between the French and English obstetric forceps which need not be described, but Tarnier's invention was applied in 1880 to the English forceps by Sir Alexander Simpson. Simpson's instrument was further modified and improved by Milne Murray.

The axis-traction forceps of Milne Murray is shown in fig. 258. The traction rods are attached by a slot at the base of the fenestrum on each side; they are curved so as to lie in accurate contact with the lower ends of the blades and the shanks; opposite the lock they are curved away from the handles, and connected together at their ends with an easily worked attachment. The ends of the traction rods lie about 3½ inches from the handles. To the ends when united is attached a transverse bar moving on a ball-and-socket joint, with which traction can be made. As the handles of the blades are only used in applying the instrument, and are not grasped when making traction, a screw is attached to them by which the grip of the blades upon the head can be retained. This is known as the 'fixation screw'; it is not intended to produce compression of the head, but simply to retain the grip of the blades when traction is being made. The handles themselves are made much lighter than in the ordinary long forceps, and may be conveniently distinguished as the

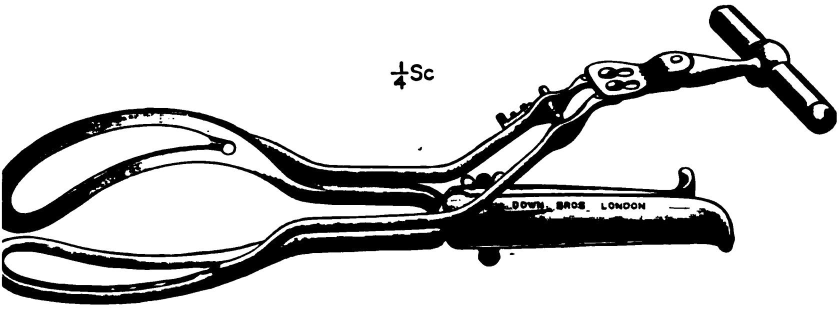

FIG. 258.—MILNE MURRAY'S AXIS-TRACTION FORCEPS.

'application' handles, the transverse bar attached to the traction rods being called the 'traction' handle. The traction rods and handle are detachable, and the whole instrument can be sterilised by boiling.

When this forceps is applied to the head at the brim, traction made with the traction handle will cause the head to descend in the axis of the brim so long as the traction rods are kept in contact with the shanks (fig. 259). The direction of the force applied is represented, in all positions of the instrument, by a straight line running from the point of application of the force (traction handle) through the centre of the fenestrum: when the head is at the brim, this line coincides exactly with the axis of the brim (fig. 259); when the head is in the pelvic cavity, it coincides with the axis of the cavity at the level occupied by the head (fig. 260)—*i.e.* a line intermediate between the axis of the brim and the axis of the outlet. As long as the traction rods are kept in contact with the shanks, the line of traction will always correspond with the axis of that part of the pelvis in which the head lies; and in pulling the head through the pelvis the application handles will be observed to incline more and more to the front as the

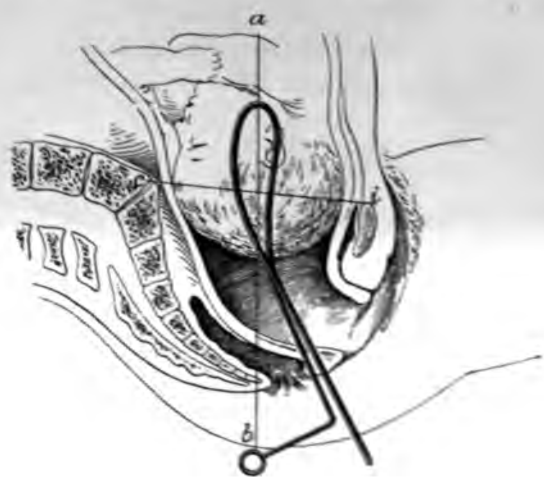

FIG. 259.—AXIS-TRACTION FORCEPS APPLIED TO THE HEAD AT THE BRIM. (MILNE MURRAY.)

a, b. Axis of pelvic brim coinciding with line of traction.

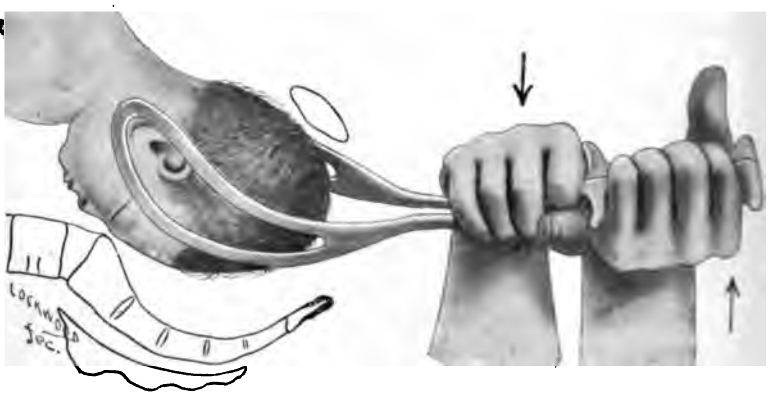

FIG. 261.—PAJOT'S MANŒUVRE. (WHITRIDGE WILLIAMS.)

[To face p. 507.

head descends (see figs. 269 and 270.) It follows that none of the force applied is wasted, for the angle of error (b, x, f) seen in the case of the short forceps and the ordinary long forceps has entirely disappeared (compare figs. 253, 257, and 259).

Various attempts have been made to apply the principle of axis-traction in other ways; only two of these need be mentioned. (1) It is maintained that axis-traction can be made with sufficient accuracy with the ordinary long forceps by the manœuvre of Pajot (fig. 261). One hand grasps the handles, making forward traction upon them; the other grasps the shanks above the lock and makes backward traction upon that part of the instrument, forming a fulcrum between the two hands, upon which the blades will swing somewhat backwards when traction is being applied. It is clear that it will be impossible to obtain even approximate accuracy of direction in this manner. (2) The second method is that of Neville (fig. 262). Neville's forceps differs from Milne Murray's in having but a single traction rod, which is attached to the forceps just below the lock by a butterfly joint. The traction

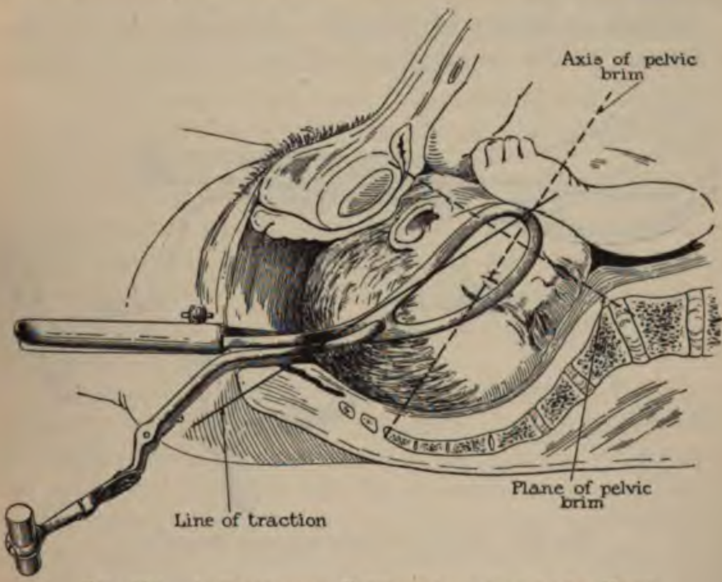

FIG. 260.—AXIS-TRACTION FORCEPS APPLIED TO THE HEAD IN THE PELVIC CAVITY. (SIMPSON.)

Note.—The line of traction is represented a little in front of its true position.

ntly jointed, but, like Milne Murray's, will move tions. The advantage possessed by this instrument it is easier to apply than Milne Murray's, but of traction is probably not so accurate.

be recollected that the axis-traction forceps is work in a pelvis of normal shape; when the ntracted so as to distort its axis many of the which the instrument possesses are lost. This course, does not apply to its use in the generally elvis.

Modes o **c Forceps.**—All varieties of forceps should ly as a means of making

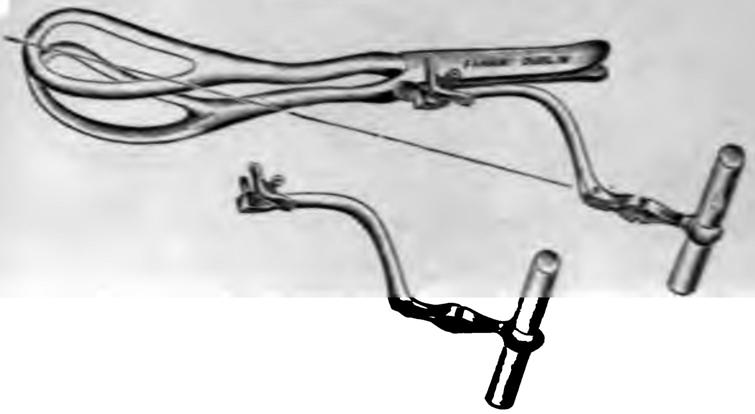

FIG. 262.—NEVILLE'S AXIS-TRACTION FORCEPS.

traction upon the head; the amount of compression exercised by the blades being only what is required to ensure a firm grasp.

Although the obstetric forceps is an instrument designed to apply traction to the head, it also exerts a certain amount of *compression* upon the head: but when properly applied the possible degree of compression is small, and is strictly limited by the cephalic curve. If the head is gripped transversely, the bi-parietal diameter cannot be reduced below 3¾ inches, a degree of compression which can do no harm. If, however, an antero-posterior grip is practised, the same degree of compression could not be applied to the occipito-frontal diameter without serious injury. As we shall see, the usual grip obtained is transverse, or slightly oblique from before backwards.

In occipito-posterior positions the forceps is sometimes used forcibly to *rotate* the head so as to bring the occiput forwards. This is objectionable, for the instrument is designed to be applied and used in the transverse diameter only of the pelvis. Rotation carries it into the antero-posterior pelvic diameter, and brings the cephalic curve of the blades into correspondence with the axis of the pelvis; while the advantage of the pelvic curve of the instrument is lost. If used for rotation, the blades must be taken off and re-applied before extracting the head.

A *lateral lever action* may be exerted during traction by carrying the handles gently from side to side; this sometimes aids extraction in a difficult case.

It is also clear that when the head is in the grasp of the forceps, the lower parts of the blades will exercise a *dilating action* upon the vulva immediately in advance of the head (fig. 269). As will be pointed out, the mere introduction of the blades often exerts a powerful *excitant action* upon the uterine contractions.

The variety of obstetric forceps which will be found most generally useful is the axis-traction forceps; and Milne Murray's pattern is to be preferred on account of its greater accuracy. To operators who have become accustomed to the ordinary long forceps, the axis-traction forceps appears clumsy and its application difficult; but students can learn to apply it quite as easily as the long forceps. It is a great advantage to carry one kind of forceps only, and this is the only kind which is sufficient for all requirements, whether of an easy or a difficult case. It is advantageous also to use the same form of instrument in all forceps operations, so as to become thoroughly familiar with its use; and while it may be admitted that a *low* forceps operation can be easily performed with the ordinary long instrument, this certainly is not the case with a *high* operation; here the axis-traction instrument is far more effective. The same must be said of pelvic contraction and all other conditions in which a considerable amount of force is required in traction; the axis-traction pattern is far more effective. Since all the force applied through the instrument is effective, and none is lost, obviously the amount of force required is reduced to the minimum.

It must also be borne in mind that this forceps does not interfere with the normal movement of rotation made by the head in passing through the pelvis, for the ball-and-socket joint on the traction handle allows the instrument and the head to rotate together. With the ordinary forceps, owing to the firm grip of the handles which is required, spontaneous rotation cannot occur, although of course forcible rotation can be performed by the operator.

It has been urged that excessive and continuous compression of the head is caused by the screwing together of the handles of the axis-traction forceps; this is not the case, for, as we shall see, continuous compression implies improper use of the instrument: the degree of compression required is only that necessary to ensure a firm grip of the head, and this can be regulated with far more accuracy by the screw than when the handles are firmly gripped in the act of making traction. The only valid objection to the instrument is its greater complexity, and the corresponding greater difficulty in manipulating it; this can readily be overcome by practice.

Indications for the Use of Forceps.—The obstetric forceps may be employed to deliver the head, in either head or breech presentations; it is designed for application to the head only (vertex, brow, face, or after-coming head). When the head is in the pelvic cavity the forceps operation is simple and easy; when the head has not passed the pelvic brim the operation is more difficult and complicated; these are respectively termed the *low* and *high* forceps operation.

Low Forceps Operation.—This operation, though simple and easy, should not be performed merely to save the time of the medical attendant, or to reduce the natural duration of the second stage of a normal labour. It is indicated by abnormal prolongation of the second stage either from primary inertia, abnormal uterine obliquity, rigidity of the pelvic floor, certain kinds of pelvic contraction, relatively large size of the fœtal head, and mal-position or mal-presentation of the head—*e.g.* occipito-posterior positions of the vertex and extension of the after-coming head. It is also indicated by many conditions (maternal or fœtal) which render the rapid termination of the second stage desirable, such as exhaustion indicated by rise of pulse-rate and temperature, cardiac disease, eclampsia, prolapse of the cord, signs of fœtal distress, &c.

High Forceps Operation.—This operation may be indicated in a normal pelvis by primary inertia, the head failing to engage, by ante-partum hæmorrhage, eclampsia or other urgent maternal complication, or by prolapse of the umbilical cord. In cases of pelvic contraction, when the conjugate diameter of the brim is 3½ inches (8·75 cm.) or more, delivery by forceps may be practised with good prospect of success, if the fœtus is not abnormally large; in a flat pelvis version is by some believed to be a more advantageous method of delivery than forceps. In the case of pelves from 3 to 3½ inches (7·5 to 8·75 cm.) forceps extraction may be practised after the operation of symphysiotomy. For other causes of obstruction, the forceps operation is very rarely indicated. In cases of marked pelvic contraction forceps should not be applied unless the fœtus is alive; this will practically always exclude its use in tonic uterine contraction; when the fœtus is dead the alternative of craniotomy should be preferred on account of the smaller risk of injuring the maternal passages. Forceps must not be applied until the cervix is about three-fourths dilated; but when otherwise indicated, digital dilatation of the cervix may be first practised under anæsthesia if necessary.

Application and Use of Forceps.—*Preliminaries.*—In cases of pelvic contraction an accurate measurement of the pelvis must first be made, in order to avoid the error of attempting to deliver with insufficient pelvic space. Careful antiseptic preparation of the hands of the operator and the vulva of the patient is of course necessary; the previously boiled forceps should be immersed in a large ewer of lysol solution (ʒj. to Oj.) or carbolic (1–40) until required for application. The bladder must be emptied by catheter, and an anæsthetic is desirable in all cases. The left lateral posture, the patient lying across the bed, is usually employed in this country, but the dorsal posture, with the legs supported and the buttocks drawn to the edge of the bed, may be used; the former has the advantage of requiring fewer assistants. When the lateral posture is used the buttocks are drawn over the edge of the bed, and the right leg must be supported throughout the operation by an assistant in the position shown in fig. 264. A detailed examination of the presenting head should be made, and posterior positions corrected if possible (see p. 239); the requisite degree of dilatation should be secured by digital manipulation if necessary.

In the high forceps operation with pelvic contraction, Walcher's position is an advantage (fig. 263). The patient is placed on her back upon a firm high table, the buttocks just projecting over the edge, and the legs hanging down. In this posture the conjugate diameter of the brim is slightly lengthened, and the angle of the plane of the brim reduced; the axis of the brim is nearly vertical, and traction must therefore be applied almost directly downwards and the legs separated by assistants.

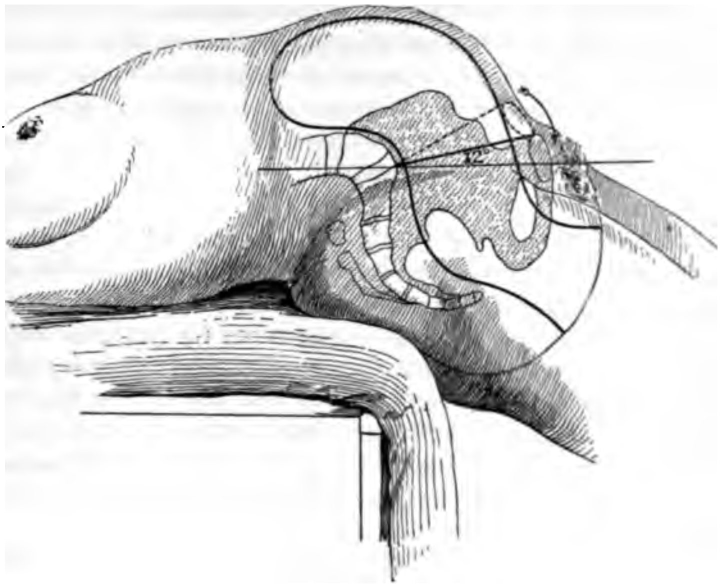

FIG. 263.—WALCHER'S POSITION, SHOWING THE CHANGE IN THE ANGLE OF THE PLANE OF THE BRIM. (EDGAR.)

Dotted line = Normal plane of brim. Continuous line = Plane of brim in Walcher's position.

Application of the Axis-Traction Forceps. (*a*) ***When the head*** *is at the brim.*—The left half is usually applied first;

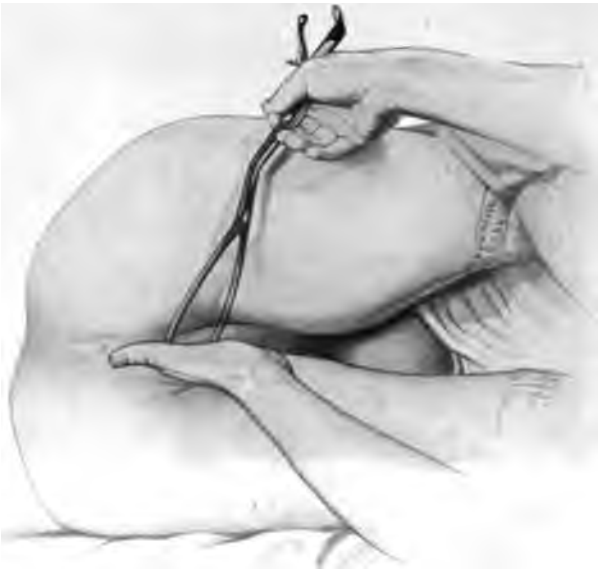

FIG. 264.—APPLICATION OF FORCEPS: I. POSITION OF RIGHT HAND IN INTRODUCING LEFT HALF OF INSTRUMENT; POSITION OF LEFT HAND WITH FINGERS PASSED INTO VAGINA.

[*To face p.* 513.

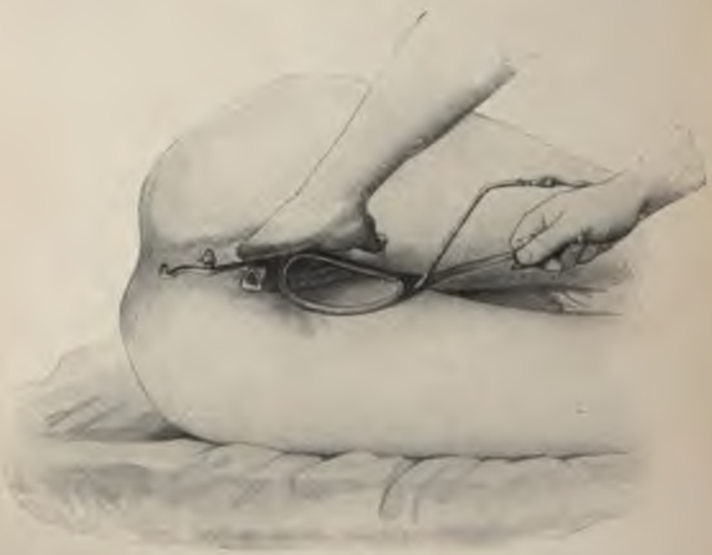

FIG. 265.—APPLICATION OF FORCEPS: II. THE LEFT HALF IS IN POSITION; THE RIGHT IS BEING INTRODUCED.

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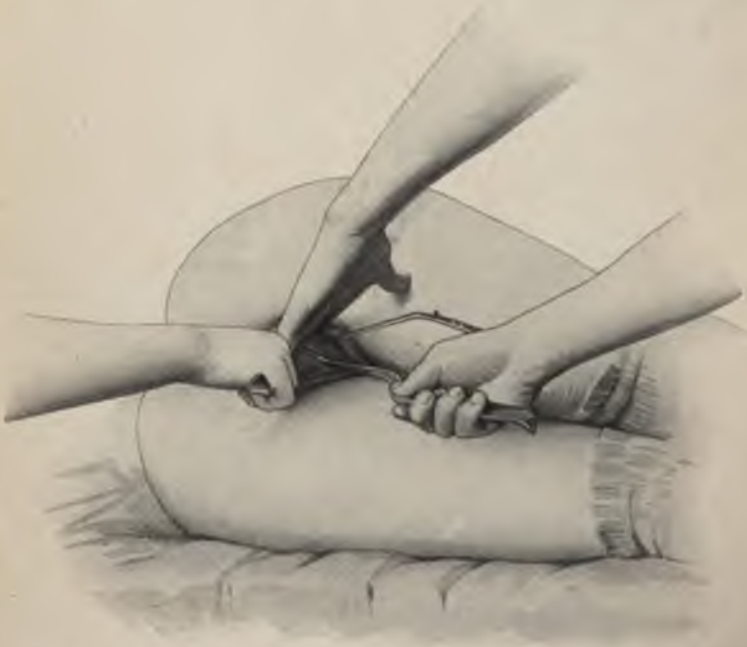

FIG. 266.—APPLICATION OF FORCEPS; III. THE RIGHT BLADE PASSING OVER THE HEAD.

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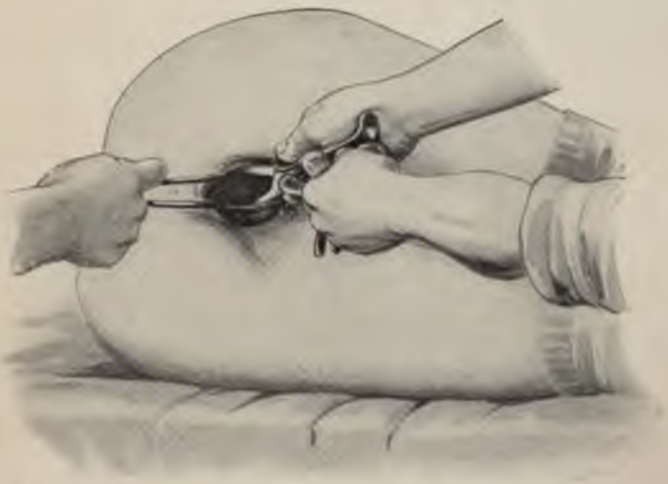

FIG. 267.—APPLICATION OF FORCEPS: IV. LOCKING THE BLADES.

[*To face p.* 513.

this will be the lower half in the left lateral posture. The handle is held lightly in the right hand, the traction rod being kept in close contact with the shank. The fingers of the left hand are passed into the vulva and carried up into contact with the cervix on the left side of the head. The blade is then passed along the palmar surface of the fingers in the antero-posterior diameter of the vulva, and directed at first backwards towards the sacral hollow, the instrument being held in a nearly vertical position as shown in fig. 264. The handle is then carried backwards in a wide sweep, and the blade at the same time directed by the internal fingers to the left (of the mother) until it lies in the axis of the pelvic brim; the blade must be kept in contact with the scalp, the lip of the external os being protected by the fingers. This movement sweeps the blade round the left (maternal) side of the head. Without exerting any force, the blade will be found to pass deeply into the pelvis until the shank comes to lie upon the perineum (fig. 265). The traction rod now lies behind the applied blade. The right half of the forceps is next taken in the right hand, the left hand is pronated, and the fingers used to guide it into the vulva. The blade is first directed towards the sacral hollow, and then, the handle being held parallel to the left thigh, the blade is directed by the fingers round the right side of the pelvis into the transverse diameter, the same precautions being taken as in introducing the left half. It is necessary to *depress* the handle of the right half in order to carry the blade upwards to the right side of the pelvis. The movement is completed by carrying the handle backwards, as the blade passes deeply into the pelvis (fig. 266). It is convenient, but not indispensable, to have the left half held in position by an assistant, as in fig. 266, while applying the right. Both traction rods should now lie behind the shanks, and the instrument is locked by taking a handle in each hand and carefully adjusting the slots (fig. 267). It is convenient to have the traction rods held back by the fingers of an assistant when locking the forceps; but this is not required after a little practice. If the instrument has been accurately applied the shanks will lie in such a position that locking is easy; sometimes, when the position of one or other half is faulty, it can only be locked by forcibly rotating one or other half. This should not be done, for serious injury to the head may result; the right half should be removed and re-applied, after properly adjusting the position of the left. After locking, the application handles are screwed lightly together with the fixation screw. They lie against the perineum, and it will be noticed that they are directed downwards in the axis of the pelvic cavity (fig. 268). Next the traction rods are connected, and the traction handle applied. A careful examination should be made before traction is begun, to make sure that nothing but the head has been included in the grip of the instrument. When the head lies in one of the oblique diameters of the pelvis it is gripped by the forceps in the manner shown in fig. 260—*i.e.* one blade lies upon one side of the face, the other lies upon or behind the ear of the opposite side.

(*b*) *When the head is in the cavity.*—The low operation is easier on account of the greater accessibility of the head. In applying the forceps the handles should not be carried so far backwards, for when the blades lie in the axis of the pelvic cavity the handles are directed forwards to a greater extent than when they lie in the axis of the brim (figs. 259 and 260).

Delivery by Axis-Traction Forceps.—Three points must be continually borne in mind in extracting the head with axis-traction forceps: (1) to keep the traction rods always in contact with the shanks; (2) to pull only during uterine contractions and pause during the intervals; (3) to ease the fixation screw whenever traction is not being made. In the high operation the direction of traction will be at first backwards and downwards (fig. 268), the perineum being pushed back by the shanks of the instrument, for the axis of the brim passes through the tip of the coccyx when prolonged downwards. As the head descends the application handles will of themselves move forwards, and the traction rods must be made to follow them (fig. 269); if this point is carefully attended to traction will always be made exactly in the pelvic axis. Little or no time will be lost in pausing during the periods of relaxation of the uterus, unless the patient is deeply anæsthetised, for the presence of the instrument in the genital canal powerfully excites uterine contractions. The object of easing the screw of the application handles is, of course, to avoid the risk of prolonged and continuous compression of the head. When the head and the pelvis are of normal size, the

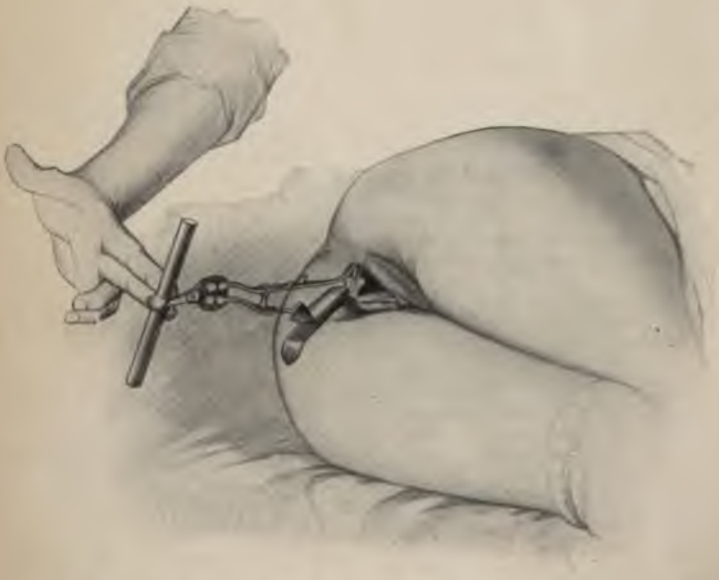

FIG. 268.—DELIVERY BY FORCEPS: I. TRACTION IN THE AXIS OF THE BRIM.

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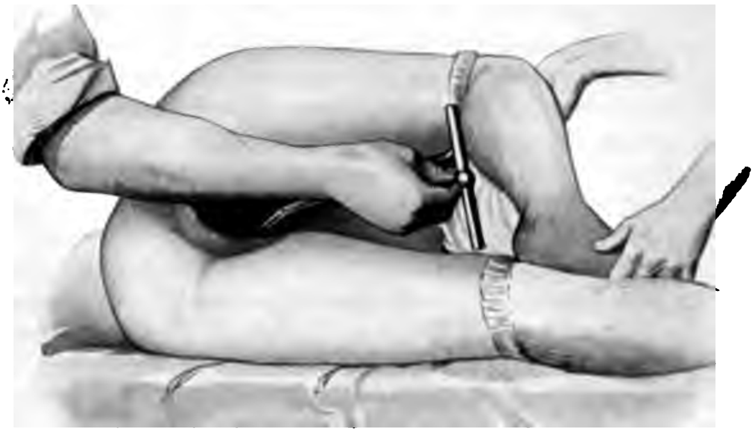

FIG. 270.—DELIVERY BY FORCEPS: III. SECOND STAGE OF EXTRACTION OF THE HEAD; THE LINE OF TRACTION HAS NOW PASSED FORWARDS UNTIL THE TRACTION RODS LIE BETWEEN THE THIGHS.

[*To face p.* 518.

amount of force required with this instrument is small, and delivery can often be effected by making traction with two fingers only. If during traction the instrument should be felt to slip, it must be taken off and re-applied. When marked rotation of the head occurs during its descent, so as to bring the blades nearly or quite into the antero-posterior diameter, the instrument should be removed and re-applied, or serious laceration of the vulva may be caused by the edges of the blades. When using the left lateral position in the final stage of extraction, the line of traction required is across the body of the patient, and the handles will come into a line almost parallel with the anterior surface of the pubes (fig. 270). The instrument may now be gripped by the shanks with the right hand, until the head is fixed in the outlet, when the forceps may be removed and the head delivered by expression. In removing the instrument the traction handle is first taken off, then the fixation screw loosened and the traction rods disconnected from one another; the blades can then be separately withdrawn.

Application and Use of Ordinary Long Forceps.—The application of the blades is carried out in precisely the same manner as the axis-traction forceps up to the locking of the handles; traction can then be at once commenced. The same precautions in delivering should be observed; the firm grip of the handles, which is necessarily used when making traction, probably exerts more injurious pressure upon the head than does the fixation screw of the axis-traction instrument; during the intervals the handles should accordingly be slightly separated without actually unlocking them, so as to diminish the pressure upon the head. Great care must be exercised throughout in directing traction as far as possible in the pelvic axis; the difficulties of effecting this have been already referred to.

Application of Forceps to the After-coming Head.—This operation may be performed when the head is retained in the *pelvic cavity* and digital methods of extraction have failed; it is quite unsuitable when the head has not passed through the brim. If the occiput is anterior, the body of the child is held forwards against the mother's abdomen, and the forceps applied in the usual manner behind it. Extraction will be easy, unless the head is extended. When the occiput is posterior, the forceps must be applied in front of the child's body.

Risks of the Forceps Operation.—When strict antiseptic precautions are taken, when proper dilatation of the cervix has been previously secured, when the conditions are favourable as regards the relative sizes of the pelvis and the fœtal head, and when extraction is practised with care and skill, the forceps operation is devoid of any serious risk *to the mother*. Serious laceration of the cervix and vaginal vault, or of the vulva, may, however, be caused by inattention to the directions laid down for the use of the instrument; lacerations in the former position are usually caused by performing the operation too early in labour; in the latter position they may be caused by slipping of the blades, or by extraction after marked rotation of the instrument has occurred, or in delivering an unrotated occipito-posterior position. Attempts to deliver by forceps when there is insufficient pelvic space may cause serious lacerations, or from extreme compression sloughing of some part of the vaginal wall may subsequently occur (see p. 415). Extraction performed too rapidly, or in the absence of uterine contractions, may lead to serious post-partum hæmorrhage. *To the fœtus* there is much more risk than to the mother: the fœtal mortality of forceps operations during the last three years at Queen Charlotte's Hospital was 44 deaths in 572 cases, a mortality of 7·7 per cent. The fœtal mortality is chiefly due to injuries to the head, such as fracture of the cranial bones with intracranial hæmorrhage, and cerebral compression causing asphyxia. Minor injuries, such as compression of the facial nerve (Bell's paralysis) and effusions of blood under the pericranium (cephalhæmatoma), may also be caused by forceps.

Cæsarean Section

This operation consists in the removal of the fœtus from the uterus by abdominal incision.

Historical.—Although Cæsarean section was practised upon the dead mother in very early times, and was indeed so prescribed by Roman law, it was not until the Middle Ages that the first operation was performed during life.

The first recorded instance occurred about the year 1500, when a Swiss pig-gelder performed it upon his own wife. The first serious treatise upon the subject was published in 1581 by Rousset. From the sixteenth to the middle of the nineteenth centuries the mortality attending it was so high as almost to prohibit the operation; Lepage states that not a single case operated upon in Paris between 1799 and 1877 recovered. The general mortality even in the first half of the nineteenth century is known to have been over 50 per cent. There is no wonder that craniotomy and symphysiotomy were at this time strongly advocated as alternative procedures. One of the chief causes of the high mortality was that the uterine incision was not sutured, as at that time surgeons believed that ligatures could not be buried in the abdominal cavity owing to the risk of their suppurating; the immediate causes of death were, no doubt, hæmorrhage and septicæmia. The first attempts to suture the uterus were made in 1835, but it was not until the introduction of Sänger's method, in 1882, that any satisfactory way of accomplishing it was devised. To this observer belongs most of the credit for the success which now attends the operation. Sänger's plan was to employ two series of sutures—one deep, the other superficial, and no important modification of this method has been since introduced. The elaboration of antiseptic and aseptic technique during the last quarter of a century stands next in importance to suture of the uterine wound as a cause of the low mortality of the operation at the present time, which, in the hands of skilled operators and under favourable conditions, does not exceed 3 per cent., while the fœtal mortality is about 5 to 6 per cent.

An important modification of the operation of Cæsarean section was introduced by Porro in 1876, six years previous to the publication of Sänger's method of uterine suture. Porro's operation consisted in amputating the body of the uterus after the extraction of the child, controlling the stump with a serre-nœud, and fixing it in the lower angle of the abdominal wound. It was introduced as a means of preventing hæmorrhage and sepsis, and was not a momentary inspiration, but the outcome of much consideration and experiment upon animals. He advocated its general adoption in the place of Cæsarean section. The expectations raised by the new operation were not generally realised, for in 1882 Godson collected 152 cases with a mortality of 56·57 per cent. To Porro, however, belongs the great credit of having been the first to conceive the idea of removing the uterus after extracting the child. Porro's operation has now been almost entirely abandoned, but the principle of removal of the uterus in certain cases has become well established, the method adopted being usually the modern one of intra-peritoneal hysterectomy.

Two Cæsarean operations have therefore to be considered: *Simple* or *Conservative Cæsarean Section*, in which the uterus, after being opened, is sewed up and returned to the abdominal cavity; and *Cæsarean Hysterectomy*, in which the uterus is removed after the extraction of the child.

Indications.—Owing to the present low mortality of Cæsarean section, the indications for its performance have been considerably extended in recent years. It has almost entirely superseded craniotomy upon the living child, and will probably in time almost entire replace symphysiotomy; while, owing to the uncertainty of the survival of the child after induction of premature labour, it is encroaching, as has been stated, upon the field of this operation also. As regards the maternal risk, it compares unfavourably with induction of premature labour, in which there is practically none; but the chances of the survival of the child in 'moderate' degrees of pelvic contraction are very much greater by Cæsarean section than by induction. It must, however, be understood that this operation is only justifiable for 'moderate' degrees of pelvic contraction, when it can be performed with adequate preparation and under favourable surgical conditions. In the case of patients seen for the first time when in labour, the alternatives of craniotomy and symphysiotomy will sometimes have to be considered even when the child is living. There is no doubt that it is better to perform craniotomy than to attempt to deliver a living child by Cæsarean section hurriedly undertaken, with insufficient antiseptic preparations in insanitary surroundings, or by an operator unaccustomed to the technique of aseptic surgery. And further, it is probably safer to perform craniotomy than Cæsarean section when repeated unsuccessful attempts have been previously made by unknown persons to deliver through the natural passages; Cæsarean section of an infected uterus being an extremely dangerous operation.

It is usual to divide the indications into *absolute* and *relative*. In the former a degree of obstruction is present which absolutely prohibits delivery by the natural passages; therefore Cæsarean section must be performed whether the fœtus is dead or alive; in the latter, delivery by the natural passages, though perhaps difficult, is possible, and the operation is resorted to from choice, not necessity.

Absolute Indications. — (1) Extreme degrees of pelvic contraction, the conjugate diameter of the brim being not more than 2 inches, or the area of the plane of the brim not more than 2 × 4 inches (5 × 10 cm.).

(2) Insuperable obstruction from—

- (*a*) Tumours of the uterus, such as cancer of the cervix, and fibroids of the lower uterine segment or cervix.
- (*b*) Tumours impacted in the pelvis which cannot be removed by vaginal or abdominal section, without first extracting the fœtus from the uterus.
- (*c*) Tumours of the pelvic bones.
- (*d*) Undilatable atresia of the cervix or vagina.

Relative Indications.—(1) Certain degrees of pelvic contraction or of obstruction from other causes, as an alternative to craniotomy, symphysiotomy, or induction of premature labour (conjugate of the brim from 2 to 3½ inches—4 to 8·75 cm.).

(2) Urgent maternal complications, such as eclampsia or concealed accidental hæmorrhage, where it is considered necessary to empty the uterus rapidly.

(3) Death of the mother, the operation being undertaken immediately after death for the purpose of extracting a living child.

Cæsarean section during labour should not be performed if the conditions indicate that the survival of the child is unlikely—*e.g.* marked slowing of the fœtal heart (50–60) or fixation of the head in the brim. In the former case it is very unlikely that the child will be extracted in time to save it; in the latter the liberation of the head may be very difficult, and the extent of the injury it has sustained is probably serious.

Indications for Removing the Uterus.—After Cæsarean section removal of the uterus may be necessitated by the following conditions:

(1) Septic infection of the uterus. It is a wise precaution to remove the uterus whenever there is reason to believe that the uterine cavity has become infected—*e.g.* offensive liquor amnii.

(2) Hæmorrhage. Sometimes uncontrollable bleeding from the uterine incision is said to occur, and removal of the uterus becomes necessary for hæmostasis.

(3) Disease of the uterus, such as malignant or fibroid tumours, or malformation, for which hysterectomy would be indicated under any circumstances.

(4) The uterus may be removed along with the appendages in osteomalacia (see p. 305).

(5) When insuperable and incurable obstruction is present, for the purpose of preventing subsequent conception.

The Operation.—When it is necessary to perform the operation hurriedly, owing to the cause of obstruction being undiscovered until labour is advanced, the prognosis is distinctly less favourable than when sufficient time is available for proper preparations. The gravity of the prognosis may be said, under such circumstances, to be influenced chiefly by the duration of labour and the risk of the uterine cavity having been infected. To lay open an infected uterus naturally involves the most serious risks of peritonitis. We have here another illustration of the importance in pelvic contraction of making an accurate diagnosis of the *degree* of contraction, so that harm may not be done by resort to methods which cannot possibly be successful. Naturally also the longer the patient has been in labour the more unfavourable becomes the prognosis for the child. It was formerly thought necessary to wait for the onset of contractions and the commencement of dilatation of the cervix, but experience has shown that there is no advantage in so doing. The prognosis is best both for mother and child when the operation is performed without waiting for the onset of labour, and when there is ample time for proper preparations to be made. The general preparations necessary are those ordinarily required for abdominal section.

The skin of the abdominal parietes should be sterilised in the usual manner from twelve to twenty-four hours before the operation, and carefully protected. If this is impracticable the skin must be sterilised under anæsthesia in the following manner: After shaving down to the pubes, it is well scrubbed with soft soap and hot water for five minutes, special attention being paid to the umbilicus; the soap is then washed off with fresh hot water, and ether poured over the skin and rubbed in with a swab. Then the skin is thoroughly swabbed with an alcoholic solution of biniodide of mercury (methylated spirit 25 parts, water 75 parts) of the strength of 1-1,000. This duty should be allotted to a nurse or an assistant who will not take part in the operation.

The best anæsthetic is chloroform, which is particularly well borne by pregnant women and affects the fœtus less profoundly than ether, owing to its lower diffusibility. An intra-muscular injection of ergotin or aseptic ergot may be made into the buttock as soon as the patient is anæsthetised; this will ensure proper retraction of the uterus after its evacuation. Before commencing the operation the presentation and position of the fœtus should be determined by palpation, and evidence obtained that it is alive, as Cæsarean section for 'relative' indications is only justifiable when the fœtus is living. An extra assistant should be at hand, and a warm bath prepared, to resuscitate the fœtus if required.

The *abdominal incision* should be made about five inches long, in the middle line, starting just below the umbilicus. It will be recollected that the abdominal parietes at term are very thin, and the incision must be made with care. Under normal conditions liquor amnii is sterile, and need not be feared; but if there has been risk of infection of the uterus, sponges or swabs should be packed round the organ before opening it, to prevent fouling of the peritoneum.

The *uterine incision* should be about four inches long, and as nearly as possible in the mesial plane of the uterus. It is therefore advisable to insert the hand and rotate the uterus if it is obvious that its anterior surface lies obliquely. Free hæmorrhage will usually occur, which, however, may be neglected for the moment. The membranes should be exposed by a small incision, which can be completed by dividing the uterine wall upwards and downwards with scissors; the amniotic sac is then opened and the hand passed to the breech, the position of which has been previously determined by palpation. The fœtus is then seized by the feet and delivered breech first, the cord is immediately clamped and divided, and the child handed over to the care of an assistant. If the placenta lies upon the anterior wall profuse bleeding will occur from the first cut in the uterus, but without pausing the operator must detach the placenta on both sides of the incision, pull it out of the wound, open the amnion, and extract the child as rapidly as possible, when the hæmorrhage can be brought under control. As soon as the child has been extracted the operator's assistant passes his hand behind the fundus, turns the retracted uterus out of the abdominal wound, and squeezes it firmly in a hot towel to control bleeding. The intestines are then protected with sterilised towels or swabs, and the placenta and membranes carefully and completely peeled off the uterine wall. If labour has not commenced, the finger should be passed through the cervix, to ensure sufficient dilatation for free drainage of the lochia.

Closing the Uterine Wound.—This is the most important part of the operation, and care and time must be expended upon it. Sänger's method is still that in general use; deep sutures are introduced at intervals of half an inch, entering the uterine wall a quarter of an inch outside the edge of the wound, passing deeply into the muscular wall but not through the whole thickness, and then brought through the opposite wall to the peritoneum at a point corresponding to the point of entrance. Intermediate superficial sutures, including serous membrane and muscle, may be introduced in the same manner, beginning a little above and ending a little below the incision. Complete and accurate adaptation of the edges of the wound is essential to success. Finally, a Lembert's suture may be run from end to end, but this is not essential. Some operators employ superimposed tiers of buried catgut sutures instead of the method of Sänger. Others think that it is unnecessary to avoid passing the sutures into the uterine cavity if complete aseptic precautions have been taken.

Sänger's point was that if the uterus was at the time, or later became, infected, septic matter might enter the peritoneal cavity along the track of the sutures, if this precaution were not taken. Sänger's method undoubtedly gives a firm uterine cicatrix. The best material for the deep sutures is silk or silkworm-gut, of which a stout size should be employed; fine silk, or catgut, may be used for the superficial ones. They can be most readily passed with a long straight needle.

Closure of the Abdominal Wound.—The uterus is now returned to the abdominal cavity, and all blood or other fluid must be cleared away from the flanks and pouch of Douglas, or wherever it may be found. Before returning it, the uterus should be firmly squeezed in a hot sterilised towel to expel any blood which may have accumulated during the suturing of the incision. If the uterus does not retract properly it can be massaged, or hot sterile saline solution (0·75 per cent.) poured over it. The abdominal wound should be closed in three layers—peritoneum, fascia, and skin—a little dissection of the thin abdominal wall being required to separate them.

Various modifications of the operation as described above have been from time to time introduced. Müller has advised that the abdominal incision should be made about eight to nine inches long, and the uterus turned right out of the abdomen before being opened. This plan enables the operator to avoid completely any escape of the uterine contents into the peritoneal cavity, by packing towels carefully around the uterus; but unless there is reason to believe the uterus to have been infected, it is quite unnecessary. The very long abdominal incision is a disadvantage; it increases the subsequent risk of hernia, and involves more exposure and handling of the intestines during the operation. Again, Fritsch has advised that the uterus should be opened by a transverse incision across the fundus; but this incision is less convenient and has no advantages over the longitudinal one. Others have advised that when opening the uterus a ring pessary should be pressed firmly upon the wall and the incision made in the comparatively bloodless space within the ring; this timid device is quite unnecessary, and has little or no effect upon the amount of blood lost.

Sterilisation of the Patient.—It is seldom justifiable to sterilise a patient after conservative Cæsarean section. This operation has now been performed with success as many as five times upon the same patient, and the risks attending it are so small that permanent mutilation in order to avoid the risk of a second operation should be discouraged. Pregnancy following Cæsarean section usually runs a normal course; in very rare instances spontaneous rupture through the uterine cicatrix either before or during labour has been reported. Sterilisation is therefore rarely required, except for the local conditions which necessitate removal of the uterus (see p. 520).

If, however, it is considered desirable for any reason to sterilise the patient by some other method than removal of the uterus, it is best to excise the Fallopian tube on each side, up to the interstitial portion. This can be done immediately after suturing the uterine incision. It has been shown that ligation of the tubes alone, or even ligation and division, may be followed by conception, through subsequent restoration of the tubal lumen.

The *after-treatment* is much the same as that of abdominal section generally. The skin sutures should be removed on the tenth day, and the patient should be kept in bed for three weeks. The amount of lochial discharge is usually small, and the involution of the uterus is not unfavourably affected. The patient is, as a rule, quite able to suckle her child, and should be encouraged to do so.

Cæsarean Hysterectomy.—This operation is performed in the same way as conservative Cæsarean section up to the point of extraction of the fœtus and the after-birth. The uterus may then be amputated at the level of the internal os, or the whole organ, body and cervix, may be removed.

Supra-vaginal Amputation. — The ovarian vessels on each side are first secured with two silk ligatures, so as either to remove or leave the ovaries as may be desired; in patients under forty-five both ovaries, if healthy, should be left. Then the round ligaments are similarly ligatured. The broad ligaments, first one and then the other, are clamped close to the uterine border, and divided between the clamp and the ovarian ligature down to the level of the internal os. Next an anterior peritoneal flap is mapped out and turned down along with the bladder; this allows the uterine arteries to be secured close to the uterine wall. The uterus is then amputated; after all oozing from the stump has been stopped, the peritoneal edges are united over it by a continuous suture of fine silk running from one ovarian artery across the pelvic floor to the other.

Panhysterectomy.—This operation is performed in the manner just described up to the point of securing and dividing the uterine arteries. The cellular tissue is then pushed down all round the cervix until the reflection of the vaginal vault is reached. The anterior fornix is then opened with knife or scissors and the incision carried completely around the cervix, when the uterus, being freed, can be lifted out. All oozing from the cut edges of the vaginal wall must be carefully controlled; a gauze drain is then pushed down into the vagina, and the peritoneum closed over it with a continuous silk suture from one ovarian artery to the other.

Supra-vaginal amputation is preferred by most operators, but total hysterectomy will be required for septic infection of the uterus or for malignant growths of the cervix, and in some cases for fibroids.

Prognosis. — The average mortality of conservative Cæsarean section has been mentioned; that of Cæsarean hysterectomy has not been computed upon a sufficient series of cases, but it is probably little higher than that of the simpler operation.

Craniotomy, Decapitation, and Evisceration

These operations are designed to reduce the bulk of the fœtal head or trunk so as to allow of its extraction through the genital canal. Recent improvements in other obstetric operations have greatly restricted the indications for destruction of the fœtus *in utero*, and there is now a general agreement that the destructive operations should not be performed upon a living fœtus, unless the circumstances of the case render any alternative procedure unduly dangerous to the mother. They will, of course, continue to hold their position as the safest means of delivering a dead fœtus in certain degrees of pelvic contraction, or in other forms of obstruction. In the case of a living fœtus the alternative procedures of symphysiotomy and Cæsarean section should be carefully considered, and only when the circumstances of the case are such as to increase greatly the average risk of these operations can it be justifiable to destroy the fœtus in order to deliver it.

A. Craniotomy.—This term includes the various methods of reducing the size of the fœtal head.

Indications.—(*a*) Obstruction of extreme degree, from pelvic contraction, from atresia, or from tumours of the soft parts, when the child is dead or Cæsarean section is refused or is unlikely to succeed in saving the child's life (see p. 519). Unless the conjugate of the brim is at least 2½ inches, extraction of a full-time fœtus is very difficult: if, however, as in a flat pelvis, the transverse diameter is relatively long, success may be obtained with a conjugate of only 2 inches. It is generally agreed that craniotomy should not be attempted unless the pelvic brim measures at least 2 inches by 4 inches (5 by 10 cm.). (*b*) Conditions under which delivery by forceps or version would be practicable, but difficult, and the fœtus is dead. (*c*) Irreducible posterior positions of the occiput in vertex and breech, or of the chin in face presentations, which cannot be delivered by forceps, and the child is dead. (*d*) Malformations of the fœtal head, such as hydrocephalus. (*e*) Urgent maternal complications necessitating rapid delivery with the minimum of maternal risk—*e.g.* eclampsia and hæmorrhage. It must be recollected, however, that craniotomy is not without maternal risk, for Pinard has recently reported 81 cases with a mortality of 11·80 per cent.; but it is probable that in some of the cases where urgent maternal complications were present, death was not due to the operation.

The operation of craniotomy consists of the two stages of (1) [illegible], and (2) [illegible].

(1) **Perforation.**—This stage consists in opening the cranial cavity and evacuating its contents. The instrument [illegible] perforators are [illegible] [illegible] when the blades

are closed. When the handles are pressed together the cutting edges are forced apart.

The necessity for antiseptic precautions in using this instrument will be understood. In perforating the fore-coming head the anterior parietal bone should be selected for the operation; in the case of the after-coming head it is usually most convenient to perforate the occipital bone. In the case of a face presentation it may be necessary to perforate the roof of the mouth or the orbit. The instrument, with blades closed, is held firmly in the crook of the handles (fig. 271, *a*) and the fingers of the other hand are passed up to the spot selected for perforation; the instrument is then introduced along the palm of this hand, care being taken to protect the vaginal walls from the cutting edges. An assistant is required to immobilise the head by suprapubic pressure

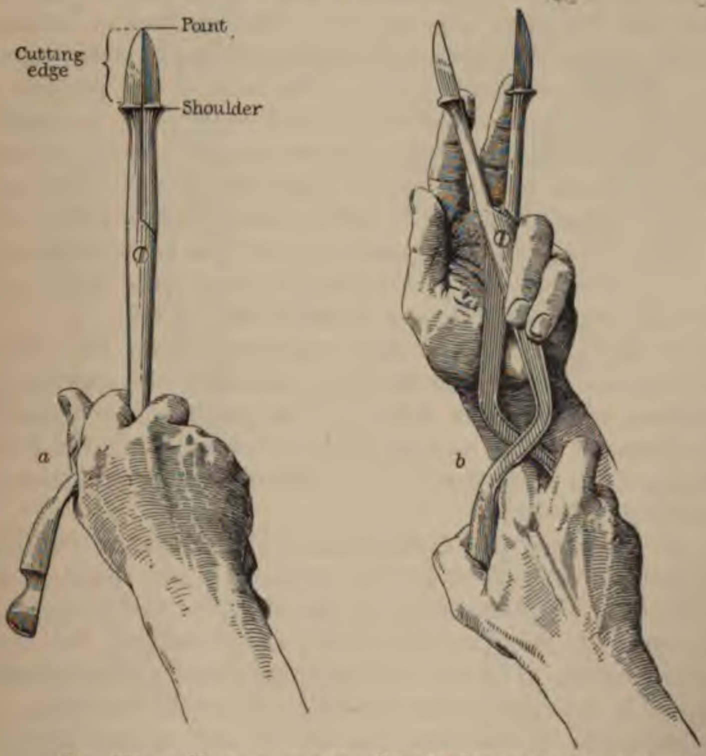

FIG. 271—*a*, HOW TO HOLD THE PERFORATOR WHEN CLOSED; *b*, HOW TO OPEN THE PERFORATOR.

when it is not fixed in the brim. The point is then pressed against the head, and by a rotatory movement is made to penetrate the bone until arrested by the shoulders of the perforator. Care must be taken to prevent the point from slipping, the fingers of the internal hand keeping it in contact with the head. The grip is then transferred to the handles, and as these are forced together the bone is lacerated by the cutting edges, two fingers of the internal hand being kept in contact with the shoulders (fig. 271, *b*). The instrument is then closed, rotated through a right-angle, and the bone cut again in a direction across the first. The head of the perforator can now be slipped inside the cranial cavity, and the brain, including the vital centres in the medulla, thoroughly broken up. It must be remembered that the strong tentorium cerebelli must be pierced in order to reach the medulla. By suprapubic pressure the greater part of the cranial contents can now be expressed; or they may be completely cleared out with the finger and a stream of boiled water if desired.

If the operation has been performed upon the after-coming head, traction on the trunk, combined with suprapubic pressure, will suffice for delivery of the perforated head, unless the degree of pelvic contraction is extreme. With the fore-coming head extraction is more difficult, and a preliminary crushing is advisable.

(2) **Crushing and Extraction.**—The amount of crushing required is determined by the available pelvic space. Two degrees must be described: (*a*) crushing the vault (*cephalotripsy*); (*b*) removing the vault and crushing the face (*cranioclasm*). The most generally useful method is cephalotripsy; in extreme degrees of pelvic contraction basilysis may be required; cranioclasm has few, if any, advantages not possessed by cephalotripsy. As extraction is performed with the crushing instruments, crushing and extraction may be considered together.

(*a*) *Cephalotripsy.*—The best form of cephalotribe is that of Braxton Hicks (fig. 272*a*). It is a pair of very powerful forceps, the blades of which are thick and narrow, with a slight pelvic curve. When closed they are in contact by their incurved tips; the maximum distance between them does not exceed an inch and a-half. The handles are locked like the forceps, and furnished with a powerful screw by means of which the blades can be forced together and the head crushed between them. The instrument is applied in the transverse diameter of the pelvis in the same manner as the forceps. On account of the narrowness and great weight of the blades, it is much more difficult to obtain a symmetrical grip of the head, and great care must be taken to direct each blade into proper position and keep it there with the fingers. When the blades have been applied and the handles locked, the screw is adjusted and crushing begun. The blades are now liable to slip backwards off the head, unless care is taken to keep the instrument in the pelvic axis and retain the blades in their proper position in contact with the head. The screw should be slowly

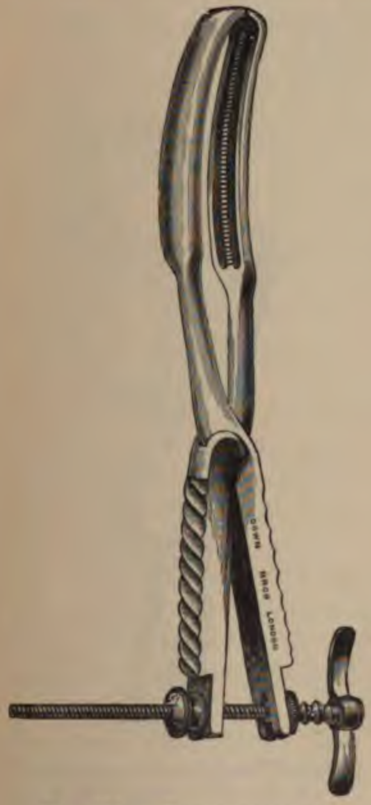

FIG. 272*a*.—CEPHALOTRIBE OF BRAXTON HICKS.

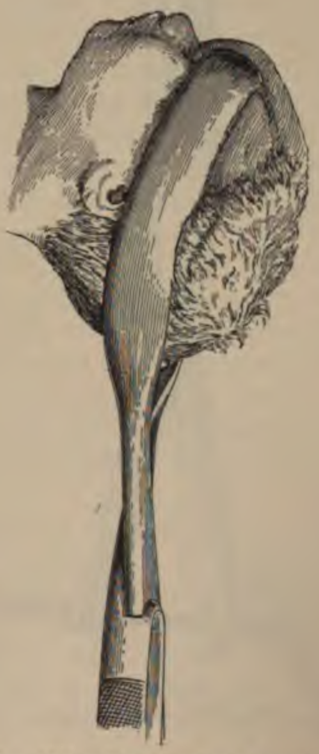

FIG. 272*b*.—CEPHALOTRIBE APPLIED TO THE SIDES OF THE HEAD.

tightened until the handles are nearly in contact, while the internal fingers take note of the position of the blades. The effect when applied to the sides of the head is shown in fig. 272*b*. If the pelvis is very small, the instrument may now be rotated into the antero-posterior diameter and the blades removed and re-applied in the transverse, so as to obtain a new grip of the head at right-angles to the first; the head is then again crushed. Perforation is an essential preliminary of crushing, except in the case of the detruncated head.

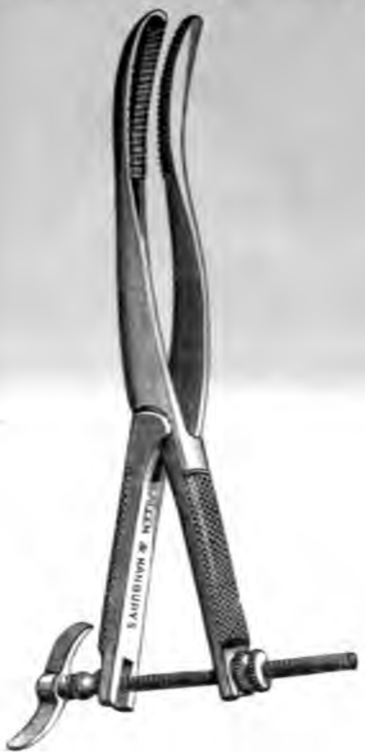

FIG. 273*a*.—CRANIOCLAST.

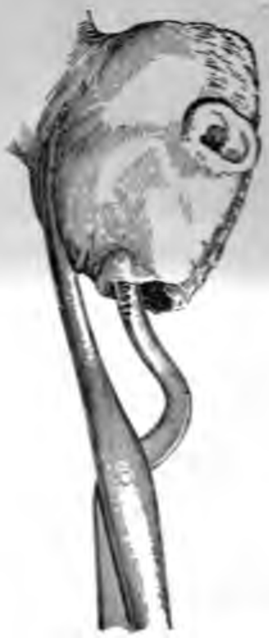

FIG. 273*b*.—CRANIOCLAST APPLIED TO THE FACE AFTER REMOVAL OF THE VAULT OF THE SKULL.

Extraction may now be performed, and care must be taken to avoid injury from bony spicules which may protrude from the perforation aperture; traction should always be made in the axis of the pelvis. In the case of a flat pelvis, extraction will be facilitated by rotating the instrument into the conjugate, so that the crushed part of the head lies in the narrowest part of the brim. An antiseptic intra-uterine douche should always be given after crushing operations.

The application of the cephalotribe to the after-coming head needs no separate description.

(*b*) *Cranioclasm.*—The cranioclast or craniotomy forceps consists of a pair of concavo-convex blades, the outer or larger of which (fig. 273*a*) is fenestrated, the smaller solid; their apposed surfaces are strongly serrated. The instrument is powerful, but not so heavy as the cephalotribe, and the handles are closed in the same way by a screw. It may be used for traction alone, or for breaking up the vault of the skull (*cranioclasm*). When used for *traction* alone, the small blade is passed into the cranial cavity through the perforation hole; the outer blade is applied either over the face, the occiput, or one or other parietal bone. The handles are then screwed tightly together and traction begun; only when the degree of pelvic contraction is moderate can delivery be effected in this way. When used for *breaking up the vault*, the small blade is passed into the cranial cavity, and the large one between the scalp and the bone; the handles are then screwed up and the portion of bone gripped by the instrument is twisted off and withdrawn. The process is repeated until the vault has been entirely removed. Extraction is then performed by first extending the head by combined vaginal and external manipulations, so as to produce a face presentation; a sharp hook is then fixed in the jaw to steady the head, and the cranioclast applied over the face, the small blade being passed into the cranial cavity, the large blade beneath the chin (fig. 273*b*). The bones of the face are then crushed, and the head, now greatly reduced in bulk, can easily be extracted.

B. **Decapitation.**—This operation may be required in impacted transverse presentations, in the case of locked twins, or with double-headed monstrosities. It may be performed with a strong pair of curved scissors, but the safest instrument to employ is the decapitation hook (fig. 274*a*). The one generally used in this country is a wide hook with a blunt point and either a cutting (Ramsbotham's hook) or a serrated edge. The handle is sufficiently long for it to be used when the neck is at the pelvic brim. In the case of a transverse presentation, decapitation may be performed as follows: If an arm is prolapsed, traction can be made upon it so as to bring the neck down as low as possible. Careful exploration with the fingers having been made to recognise the position

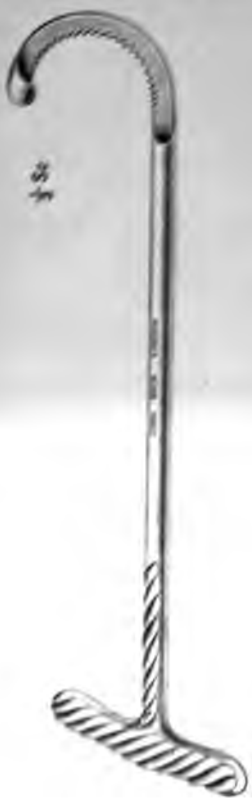

Fig. 274a.
Decapitation Hook.

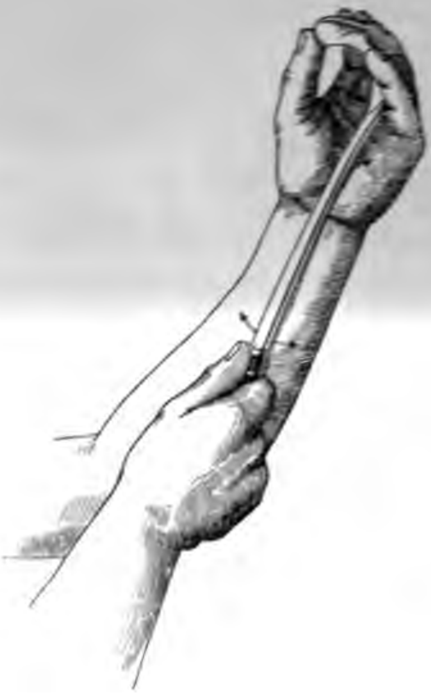

Fig. 274b.
How to Hold the Decapitation Hook.

of the back and the side to which the head lies, the hook is introduced along the palm of the hand and guided upwards between the shoulder and the anterior pelvic wall (dorso-anterior positions) until the point lies above the neck. It is then rotated through a right-angle so as to carry the cutting edge across the neck (fig. 275); the fingers are then passed up the ventral aspect of the fœtus so as to guide the point of the hook into position across the neck. Decapitation is performed by a sawing movement, the fingers of the left hand being kept in contact with the point of the hook to protect the maternal passages from injury. The soft fœtal bones are easily divided in this manner. After severing the head, the trunk is delivered either by bringing down both arms or by podalic version. It is sometimes necessary to divide the spinal column, in addition to decapitating, when the back presents. Lastly, the retained head may be delivered with forceps, if the pelvis is of normal size, or crushed with the cephalotribe if the pelvis is contracted; perforation is unnecessary, as the cranial contents will escape through the vertebral canal. In decapitating the after-coming head a long, strong pair of scissors will suffice.

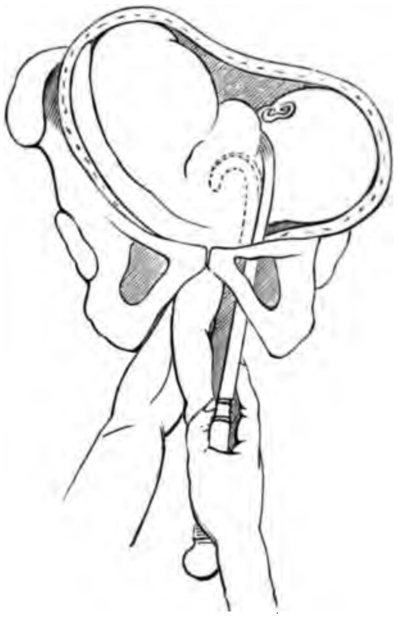
FIG. 275.—INTRODUCTION OF THE DECAPITATION HOOK. (BARNES.)

Decapitation may be performed in a somewhat different manner by the use of Braun's hook (fig. 276). This instrument is blunt, its crook very narrow and ending in a bulbous point. It is intended, not to cut through the neck, but merely to dislocate the cervical vertebræ. It is passed over the neck in the manner already described, and made to include the

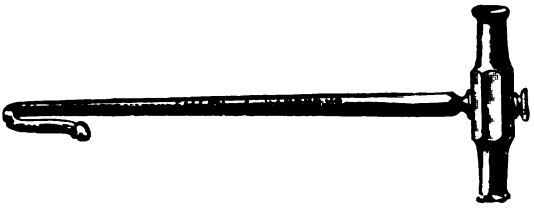
FIG. 276.—BRAUN'S DECAPITATION HOOK.

vertebral column; the hook is then forcibly rotated, so as to dislocate the vertebræ. The soft tissues are then divided with scissors. The advantage of this instrument is its small size.

Dangers of Decapitation.—In impacted shoulder cases, with marked distension of the lower uterine segment, decapitation is dangerous, for the introduction of the fingers and the hook may be sufficient to determine rupture. Under these circumstances evisceration alone or combined with division of the spinal column should be preferred. If the lower segment is not over-distended, there is no risk of rupture in decapitating.

C. **Evisceration.**—This operation consists in opening the abdomen or thorax with scissors in the most accessible position, and removing the abdominal and thoracic viscera piecemeal with the fingers. It is indicated in transverse presentation as an alternative to decapitation, and in cases of obstruction from abdominal or thoracic enlargement (ascites, cystic disease of kidneys, &c.).

D. **Cleidotomy.**—This operation consists in dividing one or both clavicles with a strong pair of scissors. Division of the clavicles is sometimes required when, owing to the large size of the trunk or the narrowness of the pelvic outlet, the shoulders cannot be extracted and the fœtus is dead.

Symphysiotomy.

This operation consists in dividing the symphysis pubis so as to produce a temporary enlargement of the pelvis sufficient to permit the delivery of a *living fœtus* by the natural passages. Though sometimes performed upon the dead woman during the sixteenth and seventeenth centuries, it was not performed upon the living woman until 1774; the result was fatal. Owing to the terribly high mortality of Cæsarean section at this period, symphysiotomy was at first frequently performed, but it soon fell into disrepute and was practically abandoned, as the results were no better than those of Cæsarean section. More recently it has again been advocated by Morisani of Naples, and Pinard of Paris, but is not generally regarded with favour owing to the extremely limited scope of its application, and the comparatively unfavourable results which it still shows.

The effects of division of the symphysis upon the pelvic diameters are not entirely clear. When, in the cadaver, the pubic bones are separated, a considerable amount of strain is placed upon the anterior ligaments of the sacro-iliac synchondroses, and these structures may suffer serious injury; in addition, rotation of the innominate bones round a transverse axis passing through these joints occurs, which carries the pubes downwards as in Walcher's position (fig. 263); lastly, a slight movement of rotation of each innominate bone round its own long axis occurs, which slightly increases the distance between the ischial tuberosities (Sandstein). The pubic bones must not be allowed to separate for more than 2½ inches (Budin and Demelin), or rupture of the sacro-iliac ligaments will occur. This degree of separation increases the conjugate of the pelvic brim by about one-third of an inch, the increase being rather greater in a markedly contracted pelvis than in one only slightly contracted. The oblique diameters of the brim are increased about twice as much, and the transverse about three times as much, as the conjugate. The marked increase obtained in the transverse diameter is, however, of little use without a corresponding increase in the conjugate. The amount of increase obtained at the outlet is probably very small, and affects the transverse diameter only.

Indications.—It is obvious from the above that symphysiotomy can only be applicable to cases of slight disparity between the size of the fœtal head and that of the pelvis. The degree of disparity in any given case is by no means easy to estimate exactly, and as precise measurement of the fœtal head in labour is impracticable, the indication for the operation has to be based mainly upon the length of the pelvic diameters. There is therefore abundant room for error. Unless the conjugate of the brim is at least three inches in length there is very little prospect of success; in pelves of greater size than this the prospect of success is better. With these reservations, symphysiotomy may be performed when the head is delayed at the brim in a flat or generally contracted pelvis, or at the outlet in a kyphotic pelvis, the degree of disparity between the pelvis and the fœtal head being small. It may be preferred to Cæsarean section in cases of this kind when labour is advanced, repeated attempts to deliver by other means have been made, and septic infection of the uterus is feared. Symphysiotomy then offers a chance of saving the child without subjecting the mother to so grave a risk as that of opening an infected uterus. The risks of symphysiotomy are, however, also increased by previous infection of the uterus. If the fœtus presents by the breech, it is impossible to estimate the relative sizes of head and pelvis until the body is born, when there is no time to perform symphysiotomy; therefore the operation is only of use in head presentations. If the fœtus is dead, craniotomy should always be preferred.

The Operation.—*Preliminaries.*—The time for performance of the operation is at the end of the first or early in the second stage of labour, since, after division of the symphysis, the child must be immediately delivered artificially; if necessary, dilatation may be hastened by Champetier's bag. The operator must of course satisfy himself that the child is alive. The pubes should be shaved and the abdominal wall and vulva disinfected. The operator requires three assistants, two of whom will support the thighs of the patient, who should be placed in the dorsal position, with the buttocks over the edge of the bed or operating table.

The operation may be performed by the *open* or the *subcutaneous* method.

Open Method.—(1) An incision two or three inches long is made in the middle line from a point just above the pubes to the lower border of the symphysis, avoiding the clitoris; this incision passes down to the bone, and in its upper part exposes the aponeurosis. By blunt dissection the clitoris is pushed downwards, and its suspensory ligament then separated from the pubes. The index finger is next passed behind the symphysis, and worked downwards in the cellular tissue until the lower border is reached; when the head is engaged in a narrow brim, this may be rather difficult. (2) The assistant passes a sound into the urethra so that its position may be readily located, and the operator divides the cartilage of the symphysis with a probe-pointed knife from above downwards. Sometimes the joint is not precisely in the middle line, and it will be necessary to explore to either side in order to find it. Rare instances occur in which the symphysis has become ossified; Gigli's saw must then be used to divide the bones. In cutting the lower part of the joint it is better to incline the knife to one or other side, so as not to injure the urethra when dividing the sub-pubic ligament; this stage requires great care. (3) The pubic bones now separate spontaneously, and the two assistants in charge of the legs abduct the flexed thighs gently until the required amount of separation is obtained; this must be measured, not guessed. The wound is then plugged with antiseptic gauze and the legs held perfectly steady during the remainder of the operation. (4) This consists in the delivery of the child, which is best done with forceps; great care must be exercised, for if much force is exerted serious injury will be done to the pelvic joints and the urethra. If the placenta is delayed, it is better to remove it by the digital method. (5) The wound is then closed with four or five deep silkworm-gut sutures, and an antiseptic dressing applied. It is unnecessary to suture the bones, but a tight pelvic binder is applied in such a position as to immobilise the innominate bones and thighs. Some operators advise that the vagina should be plugged with antiseptic gauze. A catheter should be passed immediately after the operation to make sure that the urethra has not been injured; if laceration has occurred a soft rubber catheter should be tied in for forty-eight hours.

Subcutaneous Method.—A small incision down to the bone is first made with a tenotomy knife in the middle line just below the clitoris, which should be pulled upwards as much as possible. A curved probe pointed bistoury is then inserted under the soft tissues and passed upwards nearly to the upper border of the symphysis, cutting into the front of the cartilage. The index finger of the left hand is then passed into the vagina and carried upwards until the blunt point of the knife is felt above the symphysis. The division of the cartilage is then made from above downwards, the resulting separation of the bones being observed by the finger in the vagina. A sound should be passed into the bladder and the urethra displaced as much as possible to one side during the operation. The child is then delivered, and the operation completed by the application of an antiseptic dressing and a pelvic binder.

Although symphysiotomy is an easy and simple operation, its results are disappointing, for the following reasons: (1) injury to bladder and urethra often occur; (2) the space behind the pubic bones (cavum Retzii) is difficult to drain, and when accumulations of fluid occur there they easily become infected; (3) after the operation has been successfully performed it may prove impossible to deliver the child except by craniotomy; this is explained by the difficulty of estimating the degree of disparity between the head and the [illegible]

Prognosis.—Recent statistics of this operation, compiled [illegible] cases of well-known operators, show a maternal [illegible] and a fœtal mortality of 9·39 per [illegible] the mortality is nearly double that of [illegible] regards the mother and the child. [illegible] likely to be met with are injuries to [illegible] of the operation [illegible] almost always occurs. [illegible] permanent lameness

[illegible] —The operation resembles [illegible] and the indications [illegible] the symphysis pubis. [illegible] three- [illegible] the [illegible] It is [illegible] disease in the [illegible] further that the [illegible] claimed that [illegible] the urethra. The [illegible] it is not new. [illegible]

[illegible] of the sub- [illegible] incision is [illegible] the external [illegible] It may be [illegible] the outer surface [illegible] behind the pubic [illegible] A curved metal [illegible] passed behind the [illegible] With the aid of [illegible] passed and the bone divided.

Formidable hæmorrhage may occur both from the subcutaneous tissues and from the pelvic cellular tissue.

In the *subcutaneous method* a small incision, about an inch in length, is made just above and internal to the pubic spine, and a special curved pubiotomy needle is passed behind the bone and made to emerge below the pubic arch by piercing the soft tissues in that position. Through the needle a piece of stout silk is threaded, with which Gigli's saw is drawn up behind the bone, and brought out at the suprapubic incision.

Both operations are more formidable than symphysiotomy, and it has still to be shown whether they possess any compensating advantages.

Primary Repair of the Perineum

All obstetric lacerations of the perineum exceeding half an inch in depth should be repaired immediately. Primary union can be obtained if surgical cleanliness is observed; but when lacerations are allowed to remain unsutured they frequently become infected during the puerperium, and may later on lead to the occurrence of prolapse or rectal incontinence.

Three types of laceration may be described. In the *first*, which is usually overlooked, the laceration at first sight appears to involve only the anterior edge of the perineal body; if, however, the vulva is held open with the fingers it will be seen that a comparatively deep laceration runs upwards and somewhat outwards into the vaginal wall on one or both sides (fig. 277, *a*). If this apparently trivial tear is neglected, it may lead subsequently to the condition of relaxed vaginal outlet and prolapse of the vaginal walls, for it is frequently deep enough to affect the posterior fibres of the levator ani and the anal fascia, which support the posterior vaginal wall. It should be repaired with interrupted catgut stitches, as shown in the figure.

In the *second* type the laceration involves the greater part of the perineal body and a considerable part of the posterior vaginal wall, but the anus and its sphincter escape. This type is sufficiently obvious to be generally recognised and sewed up. It is best repaired by a series of sutures introduced, some through the perineum and some through the posterior vaginal wall (fig. 277, *b*); this is preferable to passing them all through the perineal surface and endeavouring to include the upper end of the vaginal rent, for accurate apposition of the edges of the vaginal mucous membrane, so necessary for a good result, cannot be obtained in this way. Strong catgut is the best suture material.

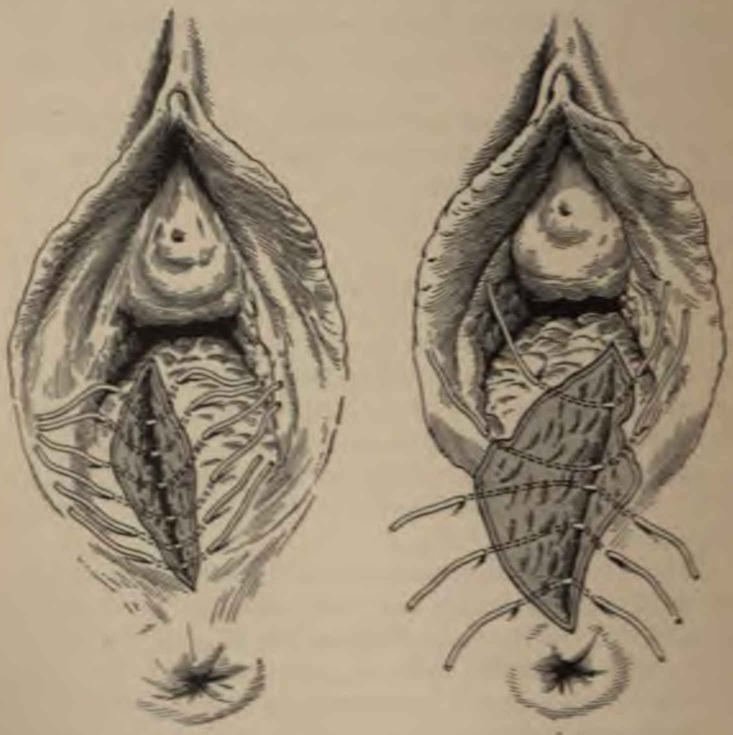

FIG. 277.—PERINEAL LACERATION: *a*. FIRST TYPE. *b*. SECOND TYPE. (EDGAR.)

In the *third* type, posterior vaginal wall, perineal body, and anus are all torn through, establishing direct communication between the vagina and rectum (fig. 278). This severe laceration requires very careful treatment, or the patient will suffer from incontinence of fæces. The edges of the rectal mucous membrane are first carefully united by a series of interrupted catgut stitches, which must be tied on the rectal side. Then the torn edges of the posterior vaginal wall are united in the same manner; and lastly deep sutures of silkworm-gut are passed through the perineal surface, the lowest of which should include the divided and retracted ends of the sphincter ani muscle.

When the delivery has occurred with the patient under the influence of chloroform, perineal sutures may usually be introduced immediately, before the anæsthesia passes off, without waiting for the expulsion of the after-birth. This obviates the necessity of giving more chloroform in order to pass the sutures when the third stage is over. The sutures should be clamped in position by artery forceps and only knotted when the after-birth has been delivered; otherwise, if digital removal of the placenta should become necessary, the operation would have to be repeated. In severe lacerations involving the rectum, it is better to wait until after the delivery of the placenta before beginning the operation, as considerable time is required in passing the sutures.

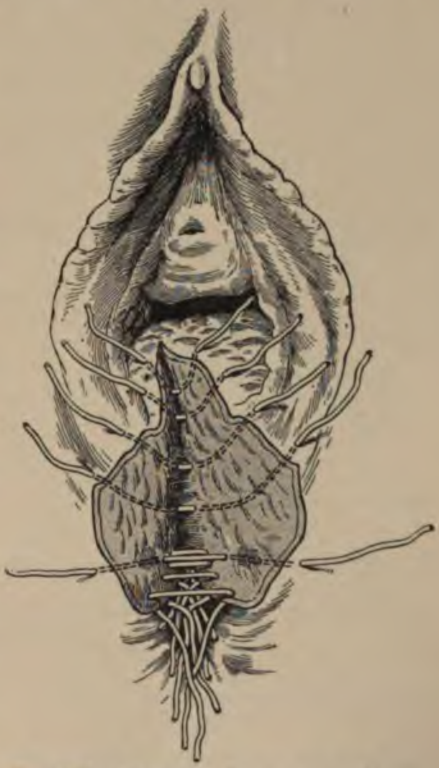

FIG. 278.—PERINEAL LACERATION: THIRD TYPE. (EDGAR.)

Note that the skin suture has passed through the torn ends of the sphincter ani muscle.

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PRINTED BY
SPOTTISWOODE AND CO. LTD., NEW-STREET SQUARE
LONDON

0124 Eden, Thomas Watts
E22 Manual of midwifery
1908 38194

NAME	DATE DUE
J. Callanan	Oct. [illegible] 1915